FY 1990/FY 1991 BIENNIAL BUDGET

DESCRIPTIVE SUMMARIES FOR THE

STRATEGIC DEFENSE INITIATIVE ORGANIZATION

JANUARY 1989

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SDIO PROGRAM ELEMENT DESCRIPTIVE SUMMARIES

Introduction and Explanation of Contents

1. GENERAL: This document has been prepared to provide information on the Strategic Defense Initiative Organization (SDIO) Research, Development, Test and Evaluation (RDT&E) program to the congressional committees during the FY 1990/FY 1991 budget hearings. The descriptive summaries provide narrative and fiscal information on the SDIO program elements and the projects contained therein.

2. COMPARISON OF FY90/91 SUMMARIES WITH THE AMMENDED FY88/89 SUMMARIES: A direct comparison of the FY90/91 and ammended FY89 submission will reveal differences resulting from the following factors:

a. A new program element, Phase I Full Scale Development, has been added to carry those projects which are expected to receive Defense Acquisition Board Milestone II approval during this budget period. In this budget submission, a single project, the Boost Surveillance Tracking System, is shown in the new program element. SDIO's Five-Year Development Plan (through FY94) reflects further increases in the new program element in anticipation of additional Phase I projects migrating to full scale development.

b. There have also been a number of adjustments caused by the progress of several projects through the Dem/Val phase towards FSD. Tasks within projects have been moved to different projects and, in some cases, entire projects have moved to a new program element. In short, SDIO's original structure, which was strictly aligned by program element responsibility, is now functionally aligned. Thus while many of the project titles do remain the same, the funding levels and descriptions in this budget submission will vary from the FY89 Ammended Budget Submission in February 1988.

c. This submission also seeks to segregate the funding and provide a separate narrative for some of the support and adjunct projects that have, heretofore, been combined with the major technical projects. Specifically,

1. the Innovative Science and Technology efforts now appear as Project 81 in each program element,

2. Support Programs now appear as Project 83 in each program element,

3. Technology Applications (formerly a portion of the Support Programs project in the SA/BM program element) now stands alone as Project 85 (still in the SA/BM program element),

4. Test & Evaluation (formerly a portion of the Support Programs project in the SA/BM program element) now stands alone as Project 47 (still in the SA/BM program element), and

5. the Countermeasures program (previously mentioned in the SATKA program element summary) now appears as Project 55 in the SLKT program element.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Budget Activity: 02 Advanced Technology Development

A. (U) RESOURCES: ($ in thousands)

Project Number & Title	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Tot Prog
01 Radar Disc & Data Coll (U)	16,267	21,175	28,955	28,952	Continuing	
02 Optical Disc & Data Coll (U)	99,078	110,594	123,822	163,747	Continuing	
03 Microwave Radar Tech (U)	17,238	14,323	28,956	30,000	Continuing	
04 Laser Radar Tech (U)	79,350	80,771	98,852	101,839	Continuing	
05 Passive Sensors Tech (U)	55,841	71,299	95,864	105,842	Continuing	
06 Signal Processing Tech (U)	68,122	81,943	100,848	106,827	Continuing	
07 Interactive Disc Tech (U)	23,141	13,960	37,941	41,932	Continuing	
08 Boost Demo/Val (U)	173,933	235,000	67,511	-0-	Completed	
09 Midcourse Demo/Val (U)	37,746	107,956	163,754	314,816	Continuing	
10 Midcourse Experiment (U)	99,701	93,591	42,930	28,953	Continuing	
11 Terminal Demo/Val (U)	36,332	72,383	144,475	150,343	Continuing	
12 SATKA Support (U)	117,215	122,590	217,548	214,114	Continuing	
81 IS&T/SBIR (U)	58,374	43,289	96,605	114,666	Continuing	
82 Delta Star (U)	7,500	-0-	-0-	-0-	Completed	
83 Support Programs (U)	43,510	31,861	32,962	35,016	Continuing	
TOTAL FOR PROGRAM ELEMENT	934,508	1100,735	1231,023	1436,000	Continuing	

B. (U) BRIEF DESCRIPTION OF ELEMENT: The Surveillance, Acquisition, Tracking and Kill Assessment (SATKA) program element is one of six established to implement the President's Strategic Defense Initiative. The program is focused on developing technology to sense information for initiation of the defensive engagement, and for battle management and assessment of the status of forces before and during an engagement against ballistic missiles. Efforts encompass signal and data processing and discrimination of threatening reentry vehicles from other objects and backgrounds. The SATKA system is complex and must operate reliably in the adverse environments caused by nuclear weapon detonations or direct enemy attacks in any of the four ballistic missile trajectory phases: boost; post-boost vehicle deployment; mid-course; and terminal. The major research areas are:

1. (U) Development and producibility of highly sensitive, radiation hardened passive sensor elements and sensor systems in a variety of wavelengths in the electromagnetic spectrum ranges of infrared, visible to ultraviolet.

2. (U) Development of signal and data processing hardware and software algorithms with emphasis on hardware size, weight, power consumption, and radiation hardness, and on software algorithm validity and efficiency.

3. (U) Collection of radar, optical, and imaging data on natural backgrounds, on signature data of ballistic missiles, post-boost vehicles, and reentry vehicles, and the development of discrimination techniques.

4. (U) Development of radar and laser imagers to discriminate between threat and non-threat objects in post-boost vehicle deployment, mid-course and terminal phases.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 01
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES ($ in thousands)

Project Title: Radar Discrimination and Data Collection (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
Radar Discrimination (U)	16,267	21,175	28,995	28,952	Cont	Cont

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

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(X) The Radar Discrimination task consists of the development, testing and evaluation of radar discrimination algorithms. XXXXXXXXXXXXXXXXXXX
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C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 01
Budget Activity: 02 Advanced Technology Development (U)

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(U) FY1989 Planned Programs:

- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (U) Continued work on the integrated discrimination evaluation plan.

(U) FY1990/1991 Planned Program:

- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: This project is managed by the U.S. Army Strategic Defense Command, Huntsville, Alabama for SDIO. Major organizations/contractors are:

- (U) MIT Lincoln Laboratory
- (U) Electronic Systems Division - Lexington, MA
- (U) Nichols Research Corporation - Huntsville, AL
- (U) USAF ESMC - Patrick AFB, FL

(U) Major subcontractor are:

- (U) Xontech - Los Angeles, CA
- (U) Ford Aerospace - Philadelphia, PA
- (U) Calspan - Buffalo, NY
- (U) RCA, Moorestown, NJ

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 01
Budget Activity: 02 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(X) Eng	XXXXXXXXXXXXXXX	XXXXXXXXXXX	see
(X) Sched	XXXXXXXXXXXXXX	XXXXXXXXXXXX	below
(U) Cost	XXXXXXXXXXXXXXX	XXXXXX	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: N/A

2. SCHEDULE CHANGES: (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

3. COST CHANGES: (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: N/A

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) MILESTONE SCHEDULE:

Milestone	Date
o (U) KDS Initial Operational Capability	FY1988
o (U) Algorithm Installation and Testing	FY1990
o (U) COBRA JUDY joint operations with LWIR sensors	FY1990

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 02
Budget Activity: 02 Advanced Technology Development (U)

A. (U) <u>RESOURCES</u>: ($ in thousands)

<u>Project Title</u>: Optical Discrimination and Data Collection (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Optical Discrimination	99,078	110,594	123,822	163,747	Cont	Cont

B. (U) <u>BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES</u>:

(U) This project acquires optical data on earth and space backgrounds, booster plumes, and reentry vehicles targets to assess and refine the capability of a Strategic Defense System (SDS) to perform the surveillance, acquisition, track, and kill assessment (SATKA) functions as well as passive optical discrimination of midcourse objects. These activities are focused on acquisition and analysis of data that support current system concept requirements, (e.g., BSTS, SSTS). Data obtained from space experiments are combined with laboratory data to develop and validate models and computer simulation codes which will be used to assist sensor design/evaluation and evaluate system effectiveness. Phenomenology of nuclear backgrounds is included in this effort.

C. (U) <u>PROGRAM ACCOMPLISHMENTS AND PLANS</u>:

(U) <u>FY1988 Accomplishments</u>:

- (X) XX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (U) Evaluation of the DELTA 181 mission and coordination with the National Test Bed Facility (NTBF) continued.

(U) <u>FY1989 Planned Program</u>:

- (U) Development of the Midcourse Space Experiment (MSX) will continue.
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (U) Continue evaluation of the DELTA 181 mission and continue assessment of upcoming events. Increased coordination with the National Test Bed Facility (NTBF) is expected.

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 02
Budget Activity: 02 Advanced Technology Development (U)

o (U) Procurement and development of sensors and target sets planned for an Exoatmospheric Discrimination Experiment (EDX) with potential flight in FY1991.

o (U) Liquid Engine plume measurements will be made at AEDC chamber.

(U) FY1990/1991 Planned Program:

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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o (U) CIRRIS IA will fly on Shuttle 39 along with IBSS.
o (U) Two SRMP launches are planned.

D. (U) WORK PERFORMED BY:

U) Major contractors are:

o (U) Boeing Aerospace Company - Seattle, WA
o (U) MIT/Lincoln Laboratory - Lexington, MA
o (U) Ball Aerospace - Boulder, CO
o (U) Nichols Research Corporation - Huntsville, AL
o (U) Air Force Ballistic Missile Office - Norton AFB
o (U) Utah State University - Logan, UT
o (U) Aerojet Electrosystems - Azusa, CA
o (U) Mission Research Corporation - Santa Barbara, CA & Nashua, NH
o (U) Physical Research Inc. - Torrance, CA

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(X) Eng	XXXXXXXXXXXXXXXXXXXXXXXXX	N/A	N/A
(U) Sched	XXXXXXXXXXXXXXXXXXXXXXXX		
(U) Cost	XXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX		

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 02
Budget Activity: 02 Advanced Technology Development (U)

NARRATIVE DESCRIPTION OF CHANGES

1. ENGINEERING CHANGES: (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXX

2. SCHEDULE CHANGES: (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: N/A

H. (U) OTHER APPROPRIATION FUNDS: MILCON

	FY1991
MAJOR CONSTRUCTION EDX Experiment, Barking Sands, Kauai, HI	$3.65M

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE:

Milestone	Date
o (U) Liquid Plume Measurements/AEDC	FY1989
o (X) XXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (U) EXCEDE III launch	FY1990
o (U) CIRRIS IA flight	FY1990
o (U) SPIRIT II launch	FY1991
o (U) EDX flight	FY1992
o (U) MSX launch	FY1993

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 03
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in Thousands)
Project Title: Microwave Radar Tech

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Radar Technology	17,288	14,323	28,956	28,953	Cont	Cont

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

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(X) Large Radar Array Technology: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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(X) Large Radar Technology: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

o (U) Reliability and radiation testing of radar modules will be completed. High level automated production of the X-band T/R modules will be detailed.

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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o (U) The LADD experiment hardware will be completed and demonstrated on the ground.

o (U) Supporting technologies addressing wide bandwidth signal processing, high speed A/D converters, ECCM/OPINE, and thermal and structural shielding will be pursued.

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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Program Element 0603220C
PE Title: S:rveillance, Acquisition, Tracking and Kill Assessement (U)

Project Number: 03
Budget Activity: 02 Advanced Technology Development (U)

(U) FY1989 Planned Program:

o (U) Production T/R modules will be tested and characterized. An advanced radar subarray will be built to demonstrate the integrated solid-state modules with new array construction techniques.

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXX

o (U) Continuing support will be provided to technologies addressing wide bandwidth signal processing, high speed A/D converters, ECCM/OPINE, and thermal and structural shielding.

o (U) Test articles developed to demonstrate technologies such as time delay wavefo:m distribution networks, distributed aperture experimental arrays, high power fast wave devices for coherent imaging, and V-band solid-state sub-arrays will be tested.

(U) FY1990/1991 Planned Program:

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX

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(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: This program is managed by the U.S. Army Strategic Defense Command, Huntsville, AL, for the SDIO.

(U) Major Contractors

- (U) Raytheon - Wayland - MA
- (U) Texas Instruments - Dallas, TX
- (U) Atlantic Research - Rome, NY
- (U) Simulation Technology Inc. - Caddo Hills, TX
- (U) Georgia Tech Research Corporation - Atlanta, GA
- (U) Electromagnetic Sciences, Inc. - VA
- (U) Dynetics - Huntsville, AL
- (U) U.S. Army Laboratory Command, Ft. Monmouth, NJ

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 03
Budget Activity: 02 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Eng	NONE		
(U) Sched	NONE		
(U) Cost	NONE		

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U) Multistatic Radar Concept was discontinued due to lack of funds in FY1988.
2. SCHEDULE CHANGES: (U) NONE
3. COST CHANGES: (U) NONE

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: N/A

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: N/A

J. (U) MILESTONE SCHEDULE:

	Milestone	Date
o (X)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X)	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 04
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in thousands)
Project Title: Laser Radar Technology (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Laser Radar Technology	79,850	80,771	98,852	101,839	Continued	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(X) This project develops and demonstrates the technology for a number of critical missions within the SDS. Laser Radar Technology includes laser transmitters, receivers, optics for both transmitters and receivers, mechanisms for steering and directing the beams, signal processing algorithms codes for calculating laser radar cross sections and system performance, and measurements. XX
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C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

- (U) Increase output power and stability in the LICD program
- (U) Measure absolute cross sections on more targets and decoys
- (U) Figure and test 1-meter Beryllium mirror.
- (U) Assemble components for the Firepond Laser Radar System tests.

(U) FY1989 Planned Program:

- (U) Perform significant demonstration experiment using the 2 KW laser radar at Firepond to actively measure and discriminate objectives deployed from payloads launched at Wallops Island, some 600 km from the transmitter.
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXX

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 04
Budget Activity: 02 Advanced Technology Development (U)

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(U) FY1990/1991 Planned Program:

- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY:

(U) In house

- (U) US Army Strategic Defense Command - Huntsville, AL
- (U) Navy PMW-145 - Arlington, VA
- (U) USAF Rome Air Development Center, Rome, NY

(U) Major Contractors

- (U) AVCO - Everett, MA
- (U) Boeing Aerospace Company - Seattle, WA
- (U) Rockwell - Woodland Hills, CA
- (U) MIT/LL - Bedford, MA
- (U) STI - Bellevue, WA

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGF	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(X) Eng	XXXXXXXXXXXXXXXXXXXXXXXXXX	One year delays	
(U) Sched	XXXXXXXXXXXXXXXXXXXX		$18M Reduction
(U) Cost	XXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXX		

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U)
2. SCHEDULE CHANGES: (U) See Cost Changes

3. COST CHANGES: (U) The LICD program schedule extended to its maximum allowable 60 month duration and the n x m heterodyne detector array development restricted to quad arrays. Large Optics program deleted some advanced concepts and allowed some contracts to expire and the two-meter SiC Be, and Fused Silica demonstration substrates slipped to 1991. Laser Radar Technology and Measurements programs severely cut for multi-kw microsecond laser technology, restricted angle-angle imaging optics development to multiple aperture concepts, and several beam steering concepts dropped.

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES:

(U) There is close coordination with Program Element #0603224C, Survivability, Lethality and Key Technologies through the SDIO Optics Committee and with Program Element #0603222C, Kinetic Energy Weapons, and with Program Element #0603221C, Directed Energy Weapons.

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: N/A

J. (U) MILESTONE SCHEDULE:

Milestone	Date
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX	XXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX	XXXXXXX

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 05
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in Thousands)
Project Title: Passive Sensors Technology

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
IR Sensors (U)	55,841	71,299	95,864	105,842	Cont	Cont

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(U) This project develops and demonstrates the infrared sensor component technology required for the performance, reliability, survivability, producibility, and affordability of the Strategic Defense Initiative surveillance systems. The specific infrared technology areas include: improving the producibility of high quality radiation hardened beryllium mirrors, infrared detectors, readout devices, on-array signal processing techniques, optical test facilities for characterizing and calibrating sensors, active cryocooler development and life testing, pilot line production demonstrations of focal plane components, cost projections for manufacturing such components, and integrated focal plane performance demonstrations. Particular emphasis is placed on the requirements for boost and midcourse surveillance because of the stringent technical performance requirements while operating in severe radiation environments. Producibility of radiation hardened seeker sensors will also be demonstrated.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

o (U) Optics Technology

- (U) Perform operational testing of IBC and IED hybrid arrays with gamma suppression signal processing.
- (U) Perform preliminary test On-Array Signal Processing chips.
- (U) Validate the Advanced Components Evaluation (ACE) hybrid array radiation test facility.

o (U) IR Focal Place Array Technology

- (U) Perform Precursor Above-the-Horizon Sensor (PATHS) demonstration of a three color LWIR module.
- (U) Complete PATHS pre-pilot production demonstration for extrinsic silicon hybrid arrays.
- (U) Perform Scanning LWIR Intrinsic Module (SLIM) LWIR HgCdTe hybrid array performance demonstration.
- (U) Perform baseline producibility demonstration on the MWIR HqCdTe Manufacturing Technology program.

Program Element: 0603220C
PE Title: Surveillance Acquisition, Tracking and Kill Assessment (U)

Project: 11
Budget Activity: 02 Advanced Technology Development (U)

4. (U) FY1991 Planned Program:

GBR-X:

o (U) Complete fabrication assembly and test of all hardware subsystems.

o (U) Complete verification tests of all software subsystems.

o (U) Integrate subsystems and initiate hardware and software testing at the system level in preparation for delivery of the system to USAKA, the field test site in FY92.

o (U) Complete construction of facilities at USAKA, the field test site.

GBR-M:

o (U) Continue analysis of operation in a nuclear environment, ECM environment and discrimination techniques.

o (U) Competitively select two contractors to conduct preliminary design for a tactical system.

o (U) Develop and refine two competitive preliminary designs and initiate effort to provide detailed cost proposals for conduct of Full Scale Development with a production option. (A single approach will be selected in FY92.)

5. (U) Program to Completion: (U) This is a continuing program. State-of-the-Art components and tactical concepts for a deployable ground-based radar for defense of CONUS and terminal Allied defenses will continue.

D. (U) WORK PERFORMED BY: This project is managed by the U.S. Army Strategic Defense Command, Huntsville, AL, for the SDIO.

o (U) Major Contractors:
  oo (U) GBR-X Development - Raytheon Corporation - Wayland, MA.
  oo (U) Contractor for the GBR-M will be selected during FY 1991.

E. (U) COMPARISON WITH FY88/1989 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	FY1990/91 COST
(X) Tech	XXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX	Moderate Risk	Low Risk
(X) Sched	Moderate Risk	XXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXX XXXXXXXX	Low Risk
(U) Cost	Low Risk	Moderate Risk	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: The GBR-X was modified to support both the midcourse and terminal phases of the Strategic Defense System. The technical risks associated with this change are considered moderate. The changes increase the physical size and complexity of the antenna, requires a more stringent angle error budget, uses a unique dual field of view antenna and allows discrimination of Reentry Vehicles (RVs) from decoys in the exoatmosphere by an active sensor.

2. (X) SCHEDULE CHANGES: The change is brought about due to the integration of more complex hardware and software on a similar elapsed time schedule and the added technical risk. The risk is considered moderate XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

3. (U) COST CHANGES: Budget year costs did not change.

F. (U) PROGRAM DOCUMENTATION:

- o (U) System Concept Paper - April 1988.
- o (U) Test and Evaluation Master Plan - June 1987.

G. (U) RELATED ACTIVITIES: None

H. (U) OTHER APPROPRIATION FUNDS:

1. (U) Procurement: None.
2. (U) Military Construction: ($ in Thousands)

FY88	FY89	FY90/91
0	16,000	0

(U) These funds provide for extensive modifications to the existing Defense Center Control Building at U.S. Army Kwajalein Atoll to accomodate the GBR-X.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) TEST AND EVALUATION DATA: Not applicable to this program.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 12
Budget Activity: 02 Advanced Technology Development (U)

A. (U) <u>RESOURCES</u> ($ in thousands)

<u>Project Title</u>: SATKA Integration and Support (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
SATKA Support (U)						
Subtask 1: Tech	86,402	97,119	118,471	185,144	Cont	Cont
Subtask 2: Systems	30,813	25,471	36,077	28,970	Cont	Cont
SATKA Support (U)	117,215	122,590	217,548	214,114	Continued	

B. (U) <u>BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES</u>:

(U) This project includes a variety of integration experiments designed to examine the interrelationships between the sensors, discriminants and information fusion considered in other parts of the program element.

(U) Midcourse Sensors: This effort is designed to provide the space-based experiment with midcourse sensors needed to prove the feasibility of such sensors, whether they are deployed on an SSTS or a GSTS. It will include definition of low cost experiments which can establish, with a high degree of confidence, this feasibility, identification of appropriate platforms for the conduct of the experiments, and acquisition of the sensors and platforms.

(X) Visible Ultraviolet Experiment (VUE): XXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX The VUE will provide the needed data base for validating high altitude targeting system concepts which could support technical intelligence, space object cataloging, and space-based satellite attack warning missions.

(X) The Infrared Background Signature Survey (IBSS) is a near-term experiment which gathers infrared, visible and ultraviolet radiation data XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX The information collected will be used to significantly increase the limited database. The IBSS instrumentation package is being developed jointly by the US and the Federal Republic of Germany (Messerschmitt-Boelkow- Blohm, MBB, is the prime contractor), and uses satellite hardware which has been flown on previous Shuttle missions.

(U) SATKA Integrated Experiments (SIE) develops an experimental network surveillance system (ENSS) to collect data on ballistic missiles from launch to impact. This data supports sensor system development, interface specifications, handoff procedures, geodesy and active and passive discrimination. These experiments support development of a system to investigate issues associated with detection, tracking, and identifying a large scale, multiple ballistic missile attack. The system will provide the data to selectively intercept and neutralize specific targets.

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 12
Budget Activity: 02 Advanced Technology Development (U)

(U) Included under Project 12 are the development of targets for use in the various measurement programs and SATKA support. Support is provided through trade studies, analysis, evaluation and technical assistance for various Sensor/Interceptor programs in support of a Strategic Defense System.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

o (U) Conduct at least four SIE missions and collect data on other targets of opportunity
o (U) Demonstrate continuous target observation from boost phase through midcourse and terminal
o (U) Validate the ENSS upgrades and improve data control systems
o (U) Continue classified efforts and target development
o (U) Complete IBSS Subsystem Design

(U) FY1989 Planned Program:

o (U) Complete integration of the IBSS System
o (U) Develop fully defined IBSS payload operations and a mission profile.
o (U) Complete IBSS crew and missions specialist training
o (U) Demonstrate full-scale, real-time multiple target tracking and handover
o (U) Conduct a specific SDIO/SIE mission
o (U) Perform detailed pre- and post-mission analysis and data reduction
o (U) Continue classified efforts

(U) FY1990/1991 Planned Program:

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

D. (U) WORK PERFORMED BY:

o (U) Analytical Services Incorporated (ANSER) - Washington, DC
o (U) Nichols Research Corporation - Huntsville, AL
o (U) Teledyne Brown Engineering - Huntsville, AL & Colorado Springs
o (U) TITAN Systems Inc. - Huntsville, AL
o (U) Colsa Inc. - Huntsville, AL
o (U) Messerschmitt-Boelkow-Blohm - Munich, FRG
o (U) SAIC - Colorado Springs, CO & Hermosa Beach, CA

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 05
Budget Activity: 02 Advanced Technology Development (U)

o (U) Cryogenic Technology

- (U) Initiate life testing on the Two-stage Rotary Reciprocating Refrigerator (R3) and the Mini-HALO cryocoolers.
- (U) Demonstration of critical components used for proof-of-concept of magnetic refrigerators which have potential to achieve cooling requirements for LWIR sensors with far smaller weight and power penalties.

(U) <u>FY1989 Planned Program</u>:

o (U) Optics Technology

- (U) Demonstrate On-Array Signal Processing with Z Technology.
- (U) Wide field-of-view (WFOV) Brassboard Fabrication.
- (U) Continue Mirror Fabrication Process Evaluation.

o (U) IR Focal Plane Array Technology

- (U) Initiate Longwave Infrared HqCdTe FPAs for Seekers.
- (U) Continue producible MWIR HqCdTe with 1st Enhanced Process Line.
- (U) Initiate Hybrids With Advance Yield for Surveillance (HYWAYS) Producibility Demonstration.
- (U) Prepare for HYWAYS producibility program pilot production of Impurity Band Conduction (IBC) hybrid arrays.

o (U) Cryogenic Technology

- (U) Demonstrate PFC Cooler Performance.
- (U) Continue Two-Stage Cooler Life Test.
- (U) Evaluate Magnetic Crycooler.

(U) <u>FY1990/1991 Planned Program</u>:

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
o (U) Initiate new cryocooler concepts for no moving parts, non-wearing machines.
o (U) Initiate superluttice detector development.

Program Element: 0603220C
PE Title: Surveillance, Acquisition Tracking and Kill Assessment (U)

Project Number: 05
Budget Activity: 02 Advanced Technology Development

D. (U) WORK PERFORMED BY:

(U) Major Contractors:
- o (U) Aerojet Electrosystems - Azusa, CA
- o (U) Hughes Aircraft - El Segundo, CA
- o (U) Garrett AiResearch - Torrance, CA
- o (U) Rockwell International - Anaheim, CA
- o (U) Arthur D. Little - Cambridge, MA
- o (U) Texas Instruments - Dallas, TX
- o (U) Santa Barbara Research Corporation - Santa Barbara, CA

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Eng		NONE	
(U) Sched		NONE	
(U) Cost		NONE	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U) N/A
2. SCHEDULE CHANGES: (U) N/A
3. COST CHANGES: (U) N/A

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: This project provides high performance, radiation hardened, producible IR focal planes and pilot line demonstration for all passive sensor elements. These include BSTS, SSTS, GSTS,(Projects 8 and 9) and several GBI and SBI interceptors, Program Element #0603222C. Producibility efforts as well as radiation hardness goals are coordinated with DARPA, DNA, and NASA.

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) MILESTONE SCHEDULE:

Milestone	Date
o (U) WFOV Brassboard Demonstration	FY1991
o (U) MWIR HqCdTe Production Demonstrations	FY1991
o (U) LWIR Repeatability Demonstration	FY1992
o (U) Beryllium Mirror Fabrication	FY1991
o (U) HYWAYS Extrinsic Silicon Production Demo	FY1991
o (U) Prototype Flight Cryocooler Performance Demonstration	FY 1993

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 06
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in thousands)
Project Title: Signal Processing Technology (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
Signal Processing (U)	68,122	81,943	100,848	106,827	Cont	Cont

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES:

(U) This project develops and demonstrates the techniques associated with on-board high speed sensor signal and data processing for multiple surveillance sensor systems and provides a radiation hardened digital and analog circuit component base supporting numerous SDS concepts for defense against a large number of ballistic missiles. To accomplish the mission objectives, key elements must perform large numbers of computations to perform surveillance, acquisition, tracking, and kill assessment of missiles and reentry vehicles. These elements must survive and continue to perform in high levels of natural and nuclear radiation. Selected elements must continue to operate through very high flash levels of a nuclear burst. High speed and low power Very Large Scale Integrated (VLSI) electronic circuits and memories with performance comparable to the DoD Very High Speed Integrated Circuit (VHSIC) Technology must be developed to achieve very high levels of performance and radiation hardening.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

- o (U) Demonstrate VHSIC I technology at level I hardness level
- o (U) Demonstrate the 50ns, 64K chip
- o (U) Start a new initiative for a 12-bit, 10MHz A/D converter.
- o (U) Continue development of techniques to achieve level II hardness for VLSI in GaAs and silicon of both digital and linear devices.
- o (U) Continue GaAs digital solid-state technology developments.
- o (U) Real-time brassboard processing demonstration of live satellite data stream using the AOSP.
- o (U) Continue GVSC Phase II to design, build, and test a basic 1750A computer for breadboard demonstration.
- o (U) Demonstrate 40 MHz breadboards with a Reduced Instruction Set Computer (RISC) architecture in the CMOS MIPS processor program.
- o (U) Demonstrate 16K SRAM on SOI

(U) FY1989 Planned Program:

- o (U) Prepare radiation hardened devices for "DISCO ELM" underground test
- o (U) Complete A/D converter design
- o (U) Initial preproduction of radiation hardened 64K SRAM

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 06
Budget Activity: 02 Advanced Technology Development (U)

- o (U) Continue support goal of space qualifiable GaAs
- o (U) Demonstrate feasibility of 100 MHz GaAs MIPS processor
- o (U) Demonstrate a GVSC Phase II 1750A computer brassboard
- o (U) Demonstrate a radiation-hardened vector processor (RHVP) brassboard
- o (U) Demonstrate a 64K SRAM on SOI

(U) FY1990/1991 Planned Program:

- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) PROGRAM PLAN TO COMPLETION: This is a continuing program

D. (U) WORK PERFORMED BY:

(U) In House

- o (U) Air Force Weapons Laboratory - Kirtland AFB, NM
- o (U) Naval Ocean Systems Center - San Diego, CA
- o (U) Harry Diamond Laboratory - Adelphi, MD
- o (U) Naval Research Laboratory - Washington, DC
- o (U) Naval Weapons Support Center - Crane, IN
- o (U) USAF Rome Air Development Center - Hanscomb AFB, MA

(U) Major Contractors

- o (U) Aerojet - Azusa, CA
- o (U) Computer Sciences Corp - Albuquerque, NM
- o (U) General Electric - Syracuse, NY and Research Triangle Park, NC
- o (U) Harris - Melbourne, FL
- o (U) Honeywell - Plymouth, MN, & Clearwater, FL
- o (U) Hughes - Carlsbad, CA & Malibu, CA
- o (U) IBM - Manassas, VA
- o (U) Mayo Foundation - Rochester, MN
- o (U) McDonnell Douglas - Huntington Beach, CA
- o (U) MIT/Lincoln Laboratory - Lexington, MA
- o (U) Nichols Research Corp - Huntsville, AL
- o (U) Raytheon - Sudbury, MA
- o (U) Rockwell - Newbury Park, CA
- o (U) Texas Instruments, - Dallas, TX
- o (U) Hughes - El Segundo, CA
- o (U) Unisys - Egan, MN
- o (U) Westinghouse - Baltimore, MD

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 06
Budget Activity: 02 Advanced Technology Development (U)

E. (U) <u>COMPARISON WITH FY89 DESCRIPTIVE SUMMARY</u>:

<u>IMPACT OF CHANGES</u> (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Eng	NONE		
(U) Sched	NONE		
(U) Cost	NONE		

<u>NARRATIVE DESCRIPTION OF CHANGES</u> (U)

1. <u>ENGINEERING CHANGES</u>: (U) N/A
2. <u>SCHEDULE CHANGES</u>: (U) N/A
3. <u>COST CHANGES</u>: (U) N/A

F. (U) <u>PROGRAM DOCUMENTATION</u> N/A

G. (U) <u>RELATED ACTIVITIES</u>: This project provides radiation hardened microelectronics technology for all other space based and interceptor elements: PE #0603223C Kinetic Energy Weapons (SBI, ERIS, HEDI) and PE #0603225C Space Based Battle Management/C3. Radiation tolerance and survivability goals coordinated with PE #0603224C Survivability, Lethality and Key Technologies. This project operates in coordination with the Defense Nuclear Agency and service radiation hardened microelectronics technology efforts.

H. (U) <u>OTHER APPROPRIATION FUNDS</u>: N/A

I. (U) <u>INTERNATIONAL COOPERATIVE AGREEMENTS</u>: N/A

J. (U) <u>MILESTONE SCHEDULE</u>:

<u>Milestone</u>	<u>Date</u>
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
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FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 07
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in thousands)
Project Title: Signal Processing Technology (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Interactive Discrimination (U)	23,141	13,960	37,941	41,932	Continued	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX Energy is directed at the unknown object and the response is used to determine if the object is a reentry vehicle. XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX Another promising ID technique uses High Energy Lasers (HEL). XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXX

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

- (U) Constructed Army Background Experiment (ABE) sensor package and integrate into Low-Power Atmospheric Compensation Experiment (LACE) spacecraft.
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- (U) Completed Multiple Wire Proportional Counter (MWPC) module and test in high intensity gamma background.
- (U) Evaluated alternative technologies for neutron and gamma detection.
- (U) Measured impulse generated by a CW laser on target materials.
- (U) Evaluated the relative performance of CW Chemical, Induction Linac Free Electron, and Pulse Lasers based on experimental measurements.

(U) FY1989 Planned Program:

- (U) Evaluate ABE data to generate requirements on NPB sensor to operate in natural space environment.
- (U) Measure performance of MWPC in intense pulse neutron and gamma environments.

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 07
Budget Activity: 02 Advanced Technology Development

- o (U) Extend measurements of delayed neutrons from Uranium fission fragments to higher neutron energies
- o (U) Design, construct, and test neutron and gamma detectors using promising new technologies
- o (U) Measure impulse on large scale replica targets generated by MIRACL

(U) FY1990/1991 Planned Program:

- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

(U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY:

(U) In House

- o (U) U.S. Army Strategic Defense Command - Huntsville, AL
- o (U) Los Alamos National Laboratory - Los Alamos, NM
- o (U) Naval Research Laboratory - Washington, D.C.
- o (U) Air Force Weapons Laboratory - Kirtland Air Force Base, NM
- o (U) White Sands Missile Range, NM

(U) Major Contractors

- o (U) United Technology Research Center, Hartford, CT
- o (U) KMS Fusion - Ann Arbor, MI
- o (U) Battelle Memorial Laboratories - Columbus, OH

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

	IMPACT OF CHANGES (U)		
CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Eng	NONE		
(U) Sched	NONE		
(U) Cost	NONE		

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U) N/A
2. SCHEDULE CHANGES: (U) N/A
3. COST CHANGES: (U) N/A

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 07
Budget Activity: 02 Advanced Technology Development (U)

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: Direct coordination is maintained with PE #0603224C, Survivability, Lethality, and Key Technologies, in examining the effect of high energy lasers and particle beams on targets and Program Element #0603221C, Directed Energy Weapons, in funding NPB and High Energy Laser Sources.

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: N/A

J. (U) MILESTONE SCHEDULE:

Milestone	Date
(U) For NPB-ID:	
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXX	XXXXXXX
o (U) ABE data collection complete	FY1990
o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (U) Preliminary Design Review for Flight Unit	FY1991
o (U) Critical Design Review for Flight Unit	FY1992
(U) For HEL-ID:	
o (U) Complete CW Laser test (small scale)	FY1990
o (U) CW Laser test (large scale)	FY1990
o (X) XXXXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX

FY 1990/1991 BIENNAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking, and Kill Assessment (SATKA)(U)
Project Title: Boost Demonstration/Validation (Dem/Val) (U)

Project: 8
Budget Activity: 02 Advanced Technology Development (U)

PICTURE/SCHEMATIC ON NEXT PAGE

POPULAR NAME: BSTS (U)

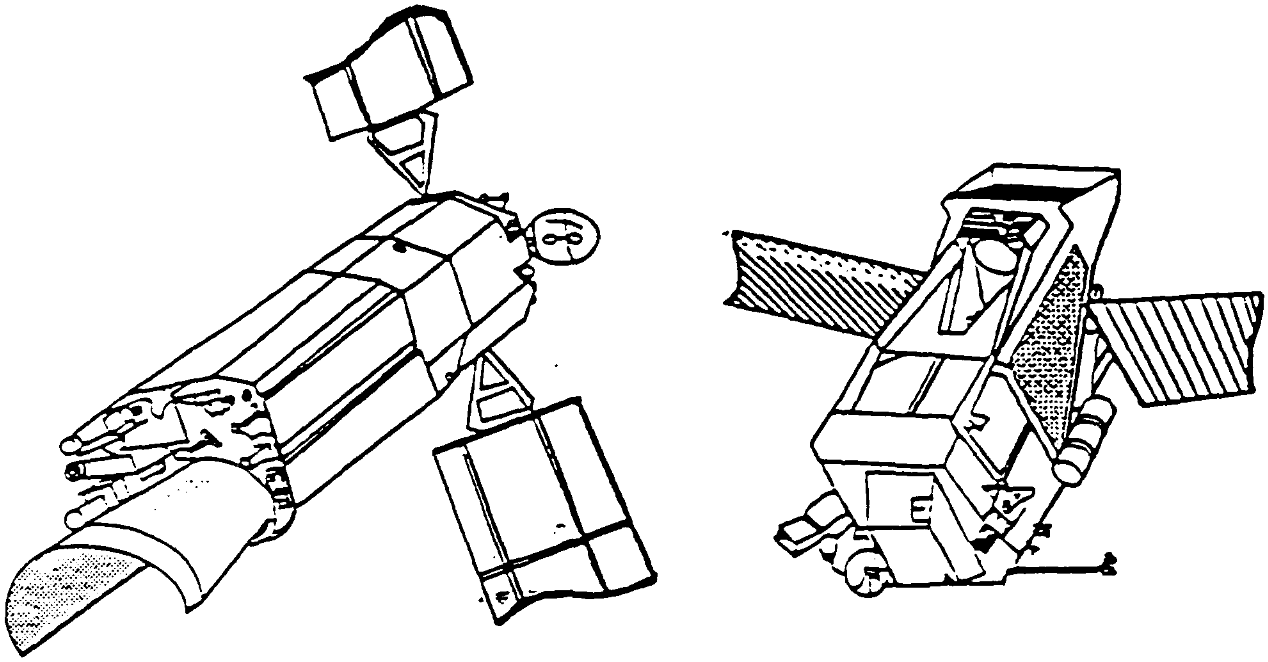
A. (U) SCHEDULE/BUDGET INFORMATION: ($ in thousands)

SCHEDULE(U)	FY 88	FY 89	FY 90	FY 91	To Complete
(U)Program Milestones		Interim Design Review	Final Design Review Milestone II		Complete FSD in Project 60, PE0604220C
Engineering Milestones (U)	Preliminary Ground Demonstrations		End-to-End Ground Demonstration		Complete
(U) T&E Milestones					
(U)Contract Milestones			Select FSD Contractor		Complete
(U)BUDGET	FY 88	FY 89	FY 90	FY 91	Prog Total To Complete
(U)Major Contract	173,993	235,000	67,511		Complete
(U)Support Contract					Complete
(U)In-House Contract					
(U)GFE/ Other					
(U)Total	173,993	235,000	67,511		Complete

Program Element: 0603220C
PE Title: SATKA (U)

Project: 8
Budget Activity: 02 Advanced Technology Development (U)

SCHEMATIC: TWO COMPETING BSTS CONCEPTS (U)



B. (U) <u>BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES</u>

(X) This project is accomplishing the technical analysis and Dem/Val necessary for a fully responsive advanced space-based system to detect and track ballistic missiles in their boost [redacted] stage. This data will be used to generate initial tactical warning/attack assessment (TW/AA) and follow-on attack status reports, which will be communicated to the National Command Authorities (NCA), to subsequent layers of surveillance systems, and, potentially, to defensive weapon systems. Since this system will potentially provide the first warning and attack assessment to the NCA, as well as handover to other SDS elements, it must be highly survivable through all levels of conflict. [redacted] Specifically, improvements are expected in on-board signal and data processing, protection against direct/indirect attacks, and in [redacted] focal planes, frame time, responsitivity, and sensitivity. The project includes system concept definition, system design, and the ground demonstration/validation of critical subsystem/system technologies. This project meets the requirements specified in OSD Master Plan for Ballistic Missile Tactical Warning/Attack Assessment provided to Congress in 1981. All activities in this project for FY90 have been reviewed and determined to be in compliance with the ABM treaty.

Program Element: 0603220C
PE Title: SATKA (U)

Project: 8
Budget Activity: 02 Advanced Technology Development (U)

(U) This project will be completed at Milestone II which is planned for FY90. Full Scale Development (FSD) will continue under Project 60, PE0604220C.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY1988 Program:
   (U) Continued development of engineering design for total BSTS including space, ground, and support elements
   (U) Fabricate and test key technology components
   (U) Hold Preliminary Review of Ground Demonstration

2. (U) FY1989 Planned Program:
   (U) Perform extensive ground testing on selected components/subsystems
   (U) Complete design of system and supporting elements
   (U) Fully detailed justification information is available at a higher classification

3. (U) FY1990 Planned Program:
   (U) The BSTS will continue to undergo extensive, end-to-end, ground testing on components/subsystems.
   (U) Specific system analysis, design, fabrication data, and schedule information is available at a higher classification level.
   (U) Efforts will focus on ground demonstration for FSD Contractor selection following Final Design Reviews.
   (U) This project will terminate with BSTS Milestone II decision. BSTS FSD will continue under Project 60, PE0604220C.

D. (U) WORK PERFORMED BY: This program is managed for the SDIO by the Air Force Space Division, El Segundo, CA.

(U) Major Contractors
   (U) Lockheed Missiles and Space Company - Sunnyvale, CA (BSTS)
   (U) Grumman Aircraft Company - Bethpage, NY (BSTS)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	FY1990 COST
(U) Eng			
(U) Sched			
(U) Cost			$262M Decrease

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U) Restructured program eliminated Dem/Val Satellite, concentrates on ground demonstration, and transfers to Project 60, Program Element 0604220C for Full Scale Development.
2. SCHEDULE CHANGES: (U) Project concludes with Milestone II in FY90

3. COST CHANGES: (U) Transfer of funding to new Program Element.

Program Element: 0603220C
PE Title: SATKA (U)

Project: 8
Budget Activity: 02 Advanced Technology Development (U)

F. (U) PROGRAM DOCUMENTATION:
(U) BSTS Technical Requirements Document - February 1985
(U) BSTS System Specification - August 1986
(U) BSTS System Requirements Document - August 1986
(U) BSTS Dem/Val Environmental Assessment - August 1987
(U) System Concept Paper (BSTS Appendix) - August 1987

G. (U) RELATED ACTIVITIES: Program Element #0604220C
Phase I Strategic Defense System (Project 60)

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: N/A

J. (U) TEST AND EVALUATION DATA: N/A

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project: 09
Budget Activity: 2 Advanced Technology Development (U)

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(U) Detection, tracking, discrimination designation, and handover of targets in midcourse are accomplished by a suite of cooperative sensors. Optical sensor concepts for the midcourse consist of the Ground-Based Surveillance and Tracking System (GSTS) and Space-Based Surveillance and Tracking System (SSTS).

(X) Midcourse Sensors (MCS) work together with hand off from Boost Surveillance and Tracking System (BSTS) to track offensive ASATS and ballistic missile, XXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX. Target data, XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX from the MCS are transmitted to SBI, GBI, and other SDS elements.

(x) The SSTS consists of a constellation of XXXXXXXXXXXXXXX in polar orbit a ground segment composed of fixed and mobile stations. The primary sensing payloads of the satellite are a XXXXXXXXXXXXXXXXXXXXXX LongWave InfraRed (LWIR) passive sensor and a visible/ultra violet passive sensor, XXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXX The early satellites will gather phenomenological data required for design optimization of surveillance and seeker systems.

(X) The GSTS is a fast-response, rocket-launched LongWave InfraRed (LWIR) sensor system boosted into suborbital flight for use in the midcourse phase. The GSTS sensor operation is integrated with SSTS and Ground Based Radar (GBR) operations to provide track and discrimination data. XXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXX

(U) The Midcourse Sensors Experiment (MCX) is the Dem/Val space flight experiment supporting the MCS. This experiment is described under PE #0603220C (Project 12 - SATKA Support).

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) Prior Year Accomplishments: FY1988

- o (U) Completed Midcourse Sensor Study and Similar Studies to define Phase One Midcourse Sensor Baseline
- o (U) Defined End-to-End Ground Demonstrations for MCS
- o (U) GSTS Dem/Val Contract Awarded

2. (U) Current Year Plan: FY1989

- o (U) Develop SSTS and GSTS design to System Requirements Review (SRR) level
- o (U) Perform initial system simulation demonstrations leading to end-to-end ground demonstration
- o (U) Continue technology risk reduction efforts

3. (U) Budget Year One Plan: FY1990

- o (U) Develop SSTS and GSTS design to System Design Review (SDR) level
- o (U) Perform breadboard processor demonstrations leading to end-to-end ground demonstration
- o (U) Continue technology risk reduction efforts

4. (U) Budget Year Two Plan: FY1991

- o (U) Continue developing SSTS Design
- o (U) Develop GSTS design to Preliminary Design Review (PRR) level
- o (U) Start integration of end-to-end ground demonstration brass-boards
- o (U) Continue technology risk reduction efforts

5. (U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY:

(U) SSTS Contractors
- o (U) Lockheed Missiles & Spacecraft Co. - Sunnyvale, CA
- o (U) TRW, Inc. - Redondo Beach, CA

(U) GSTS Contractors
- o (U) McDonnell Douglas Space Systems Co. - Huntington Beach, CA

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project: 09
Budget Activity: 2 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Eng			
(U) Sched	Lower Risk Dem/Val	MSX, Advance 2 years (See PE #0603220C Project 12)	
(U) Cost			

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) ENGINEERING CHANGES: N/A
2. (X) SCHEDULE CHANGES: See PE #0603220C Project 12 - XXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
3. (U) COST CHANGES: FY89 - +$17.95M

F. (U) PROGRAM DOCUMENTATION:

- (U) System Concept Paper - August 1987
- (U) Test and Evaluation Master Plan - June 1987

G. (U) RELATED ACTIVITIES: PE 0603220C Project 05 (Passive Sensor Technology), Project 06 (Signal Processing), Project 12 (SATKA Support - Midcourse Sensor Experiment)

H. (U) OTHER APPROPRIATION FUNDS: ($ in Thousands)

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) TEST AND EVALUATION DATA: None

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 10
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES ($ in Thousands)
Project Title: Midcourse Experiment (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
AOA (U)	99,701	93,591	42,930	28,953	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(U) The Airborne Optical Adjunct (AOA) platform provides an Long Wavelength Infrared (LWIR) testbed for the midcourse sensors system. It supports both the Space Surveillance and Tracking System (SSTS) and Ground-Based Surveillance and Tracking System (GSTS) with collection of multitarget data, verification of sensor operation, and validation of processing techniques and algorithms. The AOA platform consists of an LWIR sensor mounted atop a modified Boeing 767 aircraft. AOA is a technology validation experiment which will acquire, track, discriminate, and provide handover coordinates to a ground-based radar of midcourse target trajectories for ICBMs launched from various test ranges. AOA will validate the functional operation of airborne LWIR sensors by assessing the capability to acquire targets at long ranges, to perform discrimination, to perform bulk filtering, and to provide accurate handover data to other tracking elements. The AOA will also provide a design data base for future programs in the areas of design and operation of LWIR sensors, real-time on-board signal and data processing, performance of an integrated payload in an aircraft environment, and signatures of atmospheric backgrounds, targets, and aero-optic effects. The Airborne Optical System (AOS) would be an operational airborne surveillance system that could support the SATKA functions in an SDS in late midcourse and early reentry. There are currently no plans for the AOS in the phase one system architecture. Many of the key technology issues are being addressed by the various measurement programs.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

- (U) Completion of flight mission data software
- (U) Sensor and sensor platform delivery to Boeing
- (U) Aircraft configuration for mission equipment installation
- (U) Sensor Integration in the System Integration Laboratory

(U) FY1989 Planned Program:

- (U) Installation and checkout in aircraft
- (U) Begin Continental US (CONUS) flights
- (U) Complete AOA system integration and CONUS testing

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

Project Number: 10
Budget Activity: 02 Advanced Technology Development

(U) FY1990 Planned Program:

- (U) Deploy AOA to USAKA and conduct calibration and flight testing
- (U) Initiate AOA measurements program
- (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXX

(U) FY1991 Planned Program:

- (U) Complete USAKA flight tests
- (U) Begin testbed flights supporting other SDI programs

(U) Program to Completion: This is a continuing Midcourse Sensors Testbed program.

D. (U) WORK PERFORMED BY:

(U) Major Contractors
- (U) Boeing Aerospace Company - Seattle, WA
- (U) Boeing Commercial Airplane Company - Seattle, WA
- (U) Honeywell - Minneapolis, MN
- (U) Hughes Aircraft Company - Los Angeles, CA
- (U) Teledyne Brown Engineering - Huntsville, AL
- (U) Nichols Research Corporation - Huntsville, AL

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Tech		N/A	
(U) Sched		N/A	
(U) Cost		N/A	$21.1M increase

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U) None
2. SCHEDULE CHANGES: (U) None
3. COST CHANGES: (U) Program rebaselined to reflect new schedule. $8.6M of the increase is needed to incorporate FY90/91 contract changes making AOA on airborne surveillance testbed. A $5M cut (not reflected in the $21.1M figure above) will take effect Jan 89.

F. (U) PROGRAM DOCUMENTATION

- (U) System Concept Paper - August 1987
- (U) Test and Evaluation Master Plan - August 1987

G. (U) MILESTONE SCHEDULE:

Milestone	Date
o (U) Complete system integration in aircraft	FY1989
o (U) Complete CONUS testing	FY1989
o (U) Initiate flight test program at USAKA	FY1990

H. (U) RELATED ACTIVITIES: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) OTHER APPROPRIATION FUNDS N/A

FY 1990/1991 BIENNAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance Acquisition, Tracking and Kill Assessment (U)

Project: 11
Budget Activity: 02 Advanced Technology Development (U)

PICTURE/SCHEMATIC ON NEXT PAGE

POPULAR NAME: GBR (U)

A. (U) SCHEDULE/BUDGET INFORMATION ($ in thousands):

SCHEDULE(U)	FY 88	FY 89	FY 90	FY 91	TO Comp
Program Milestones (U)	Restructured GBR Program to include Midcourse Sensor Study Direction.	Milestone I Decision to formally include GBR in SDS Phase I Program. GBR-X System Design Review.	Define and develop discrimination algorithms. GBR-X Critical Design Review.	Initiate Preliminary Design of the Phase I Midcourse GBR.	Continuing
Engineering Milestones (U)					
T&E Milestones (X)			XXXXXXXXXXX XXXXXXXXXXX	XXXXXXXXXXX XXXXXXXXXX XXXXXXXX String Test.	Continuing
Contract Milestones (U)	Renegotiated GBR-X Contract to reflect Midcourse Sensor Study requirements	Concept Definition Study Contract for a Phase I Midcourse GBR Awarded.		Selection of two contractors to do Preliminary design of Phase I Midcourse GBR.	Continuing

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)

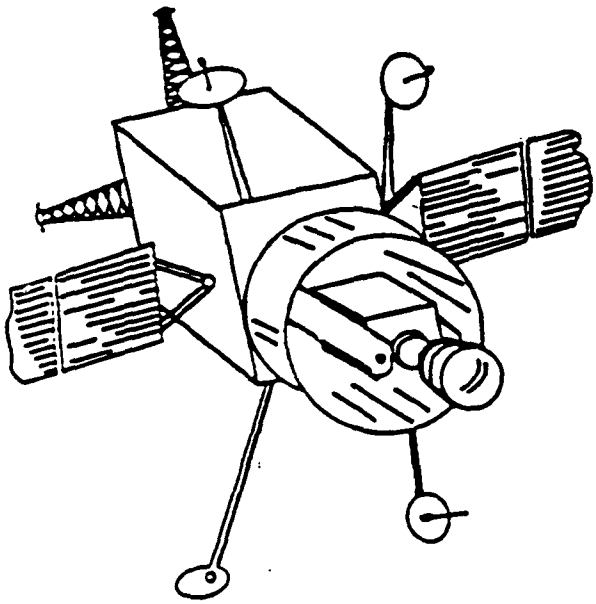
Project: 11
Budget Activity: 02 Advanced Technology Development (U)

BUDGET (U)	FY 88	FY 89	FY 90	FY 91	Progm Total
Major Contract (U)	30,233	62,628	89,673	76,994	Conti-nuing
Support Contract (U)	6,649	9,755	39,302	57,849	Conti-nuing
In-House Contract (U)	0	0	0	0	Conti nuing
GFE/ Other (U)	0	0	15,500	15,500	Conti-nuing
(U)Total	36,882	72,383	144,475	150,343	Conti-nuing

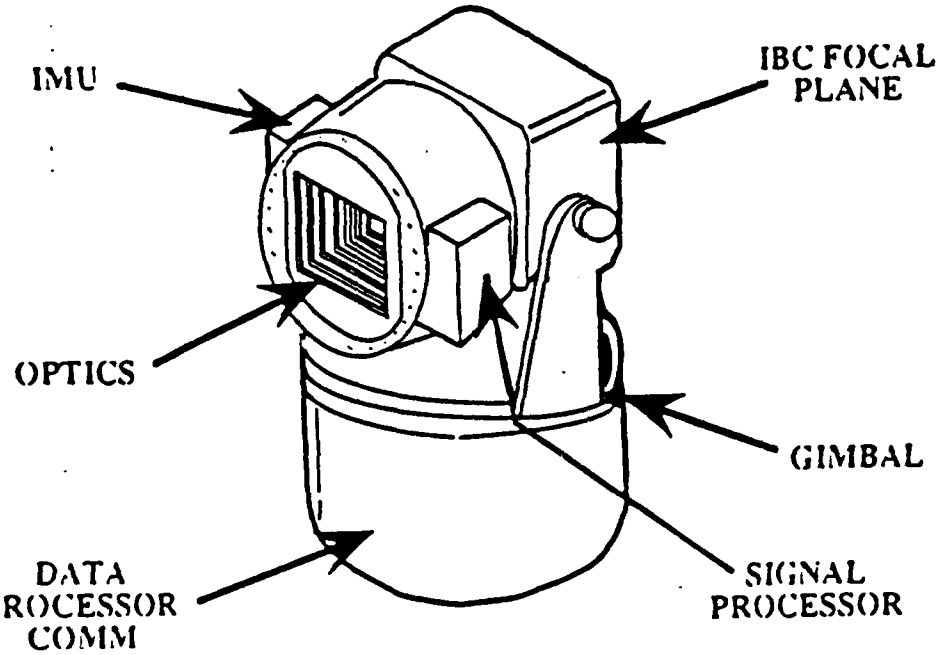
B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(X) The GBR-X (formerly named the Terminal Imaging Radar) is a ground-based, XXXXXXXXXXXXXXXXXXXXXX, technology demonstration radar currently under development XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXX The original radar design was modified in FY 1988 to provide XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXX The follow-on Ground-Based Radar program would develop a concept for a tactical, late midcourse defense radar to meet the Antiballistic Missile (ABM) threat should the decision to deploy such a growth option to the SDS be made. The Ground Based Radar would be developed for the future threat with enhanced capabilities developed from the demonstration program and other associated technology programs in the radar and discrimination areas.

SSTS Concept



GSTS Concept



Program Element: 0603220C
PE Title: Surveillance Acquisition, Tracking and Kill Assessment (U)

Project: 11
Budget Activity: 02 Advanced Technology Development (U)

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) Prior Year Accomplishments:

o (U) Evaluated proposals from contractors and Midcourse Sensor Study Group for restructured GBR.
o (U) Continued the development of GBR-X hardware.

2. (U) Current Year Plan:

o (U) Restructure GBR Program to incorporate Midcourse Sensor Study (MCSS) results into radar program.
o (U) Define and develop discrimination algorithms, signal procesing, and other related functions.
o (U) Continue building GBR-X to support technology and discrimination validation.
o (U) Award contract for a Concept Definition Study of the Phase I midcourse radar.

3. (U) FY1990 Planned Program:

FOR EXPERIMENTAL GROUND BASED RADAR (GBR-X):
o (U) Complete initial design of discrimination algorithm and target classification schema and initiate software coding. Continue to analyze discrimination techniques and modify software as necessary.
o (U) Fabricate, assemble, and test subassemblies as follows: transmitter, receiver, signal processor, antenna (including phase shifters), beam forming networks, test console, and turret.
o (U) Conduct software coding and testing operations for the operating system, applications program, test control program, post processing system.
o (U) Complete assembly and conduct tests of the antenna pilot array.
o (U) Exercise configuration control over all system and subsystem specifications.
o (U) Initiate construction of required facilities at USAKA, the field test site.

FOR MIDCOURSE GROUND BASED RADAR:
o (U) Conduct performance analysis of operations in a nuclear environment and an ECM environment. Conduct Survivability analysis.
o (U) Define concepts for a tactical system supported by effectiveness and cost tradeoff studies. Establish performance requirements for a tactical system.
o (U) Formulate a request for proposal and initiate competitive procurement activities for conduct of a preliminary tactical system design.

- o (U) Univ. of Arizona, Lunar & Planetary Laboratory - Tucson, AZ
- o (U) Defense Science, Inc. - McLean, VA
- o (U) Physical Sciences, Inc. - Andover, MA
- o (U) Utah State Univ. - Ogden, UT

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

CHANGE	IMPACT OF CHANGES (U) SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Eng		NONE	
(U) Sched		NONE	
(U) Cost		NONE	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U) N/A
2. SCHEDULE CHANGES: (U) N/A
3. COST CHANGES: (U) N/A

F. (U) PROGRAM DOCUMENTATION:

- o (U) Test and Evaluation Master Plan - June 1987
- o (U) Draft Program Plan - November 1987
- o (U) SIE Program Plan - July 1988

G. (U) RELATED ACTIVITIES: This program is closely related to and coordinated with the National Test Bed, Program Element #0603223C and STARLAB, Program Element #0603221C programs.

H. (U) OTHER APPROPRIATION FUNDS: N/A

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS:

J. (U) MILESTONE SCHEDULE:

Milestone	Date
o (U) Deliver IBSS to Launch Site	FY1990
o (U) Launch IBSS on Shuttle	FY1990
o (U) Demonstrate Real-Time Discrimination	FY1990
o (U) Integration of new sensor for SIE	FY1991

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking & Kill Assessment (U)
Project Number: 81
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)

Popular Name	FY88 Actual	FY89 Estimate	FY90 Estimate	FY91 Estimate	To Complete	Total Program
Innovative Science and Technology	58,374	43,289	96,605	114,666	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

Explores innovative technologies for sensing. Seeks revolutionary breakthroughs in technologies that would make a leap in capability for SDI sensing. The funding totals also include all SDI SBIR awards, which make about a third of FY 89 total.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments: IST research advanced many innovations for consideration by SDI system designers. All broke a technological barrier. The most compelling will help to revolutionize electronics packaging. For example:

- (U) Made monocrystalline diamond on a metallic substrate.
- (U) Invented a cryocooler gas mixture that septuples cooling rates for infrared sensors.
- (U) Painted copper conductors on a substrate with a laser to shrink electronics packaging so well that the contractor invests two dollars for every SDI dollar.
- (U) Inverted gallium arsenide by growing a razor-thin layer of silicon on GaAs and thus cut power loss by two-thirds.
- (U) Predicted telltale ultraviolet signals from an ICBM in flight.
- (U) Made a superconducting Josephson junction at 15 degrees Kelvin to enable a tiny, voltage tunable Terahertz oscillator for communications.
- (U) Proved atomic layer epitaxy could make the thinnest and most highly strained quantum wells ever reported.
- (U) Tripled the second order non-linearity of optical materials to enable optical shutters and optical computing.
- (U) Bypassed the diffraction limit to make the world's tiniest light spot.
- (U) Found a bacterial protein that could switch optical computers fast enough to act like a neural net.
- (U) Deposited the first-ever calcium difluoride at 150 degrees Celsius for content-addressable memory to shrink computers.

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking, & Kill Assessment (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

(U) FY1989 Planned Program: IST efforts will continue to explore the cutting edge of sensing technologies by pursuing the following projects:

o (U) Develop a superconducting infrared detector to operate in the 2-20 micron wavelengths to give a thousand fold reduction in cryocooler size.

o (U) Develop the first diamond MESFET with monocrystalline, semiconductor quality thin-film diamond.

o (U) Develop Atomic Layer Epitaxy as an industrial process for producing large scale gallium arsenide integrated circuits.

o (U) Continue to find and seize opportunity to make small but critical capital investments in potentially revolutionary technologies for SDI sensing needs.

(U) FY1990/1991 Planned Program: Continue exploratory initiatives. Specific programs cannot be predicted.

(U) SBIR Accomplishment and Plans: No SBIR Phase 2 has yet been completed. SDI has selected 21 Phase 2 winners in SATKA technologies. About half have started the Phase 2 work. In FY88 it also selected 15 new Phase 1 winners. The first Phase 2 completions will happen in FY89. SBIR awards will be made in accordance with PL97-219 to the best proposals offered across all the technical topics solicited by SDI.

D. (U) WORK PERFORMED BY: Various institutions (universities, private firms, national laboratories, federally funded research centers) under contract to Office of Naval Research and other agencies.

E. (U) COMPARISON WITH FY88 DESCRIPTIVE SUMMARY: Technical accomplishments are all first-ever events.

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION: N/A

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)

Popular Name	FY88 Actual	FY89 Estimate	FY90 Estimate	FY91 Estimate	To Complete	Total Program
Innovative Science and Technology	19,315	15,000	43,130	40,565	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Explores innovative technologies for directed energy weapons. Seeks revolutionary breakthroughs in all technologies that would make a leap in capability for SDI directed energy concepts. The funding totals also include all SDI SBIR awards, which make about a third of FY 89 totals.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments: IST research advanced many innovations for consideration by SDI system designers. For example:

- o (U) Linked two high-power (1.5 Gigawatt) microwave sources in a precursor of a phased array that could greatly multiply power levels for beams projected into space.
- o (U) Measured high atmospheric clouds invisible to the eye but fatal to a killer laser beam.
- o (U) Propagated 800 amperes of 600 KeV electrons through a stellerator coil five winding periods long with no measurable charge or current loss.
- o (U) Concluded that a mitigated link design will be needed to assure electromagnetic links in a disturbed environment.
- o (U) Exploited the new C-to-A transition to triple the efficiency of excimer lasers and allow them to be tunable for the first time.
- o (U) Made a neon plasma fluoresce when pumped with x-rays as a step on the road to inexpensive x-ray lasers.
- o (U) Impeached a widely held law of physics on cross sections of crystals.
- o (U) Found a way to beat the r-squared law of wave propagation for electromagnetic energy to open the possibility of electromagnetic missiles.

(U) FY1989 Planned Programs: IST efforts will continue to explore the cutting edge of laser technologies. For example:

- o (U) Develop a bright laboratory x-ray laser using pulsed power technology.
- o (U) Demonstrate a high-gradient compact particle accelerator using a recirculating induction linear accelerator.

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

c (U) Demonstrate phased array microwave sources with many sources ganged together.

c (U) Continue the search for revolutionary technologies.

(U) FY1990/1991 Planned Program: Continue exploratory initiatives. Specific projects cannot be predicted.

(U) SBIR Accomplishment and Plans: No SBIR Phase 2 has yet been completed. SDI has selected 30 Phase 2 winners in DEW technologies. About half have started the Phase 2 work. In FY88 it also selected 60 new Phase 1 winners. The first Phase 2 completions will happen in FY89. SBIR awards will be made in accordance with PL97-219 to the best proposals offered across all the technical topics solicited by SDI.

D. (U) WORK PERFORMED BY: Various institutions (univesities, private firms, national laboratories, federally funded research centers) under contract to Air Force andother agencies.

E. (U) COMPARISON WITH FY88 DESCRIPTIVE SUMMARY: Technical accomplishments are all first-ever events.

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: IST contributes technology advances to all SDI program elements and to military and civil applications. Many of technical advances will have wide impact on military and civil technology.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Not Applicable. Research is the forefront of technology where events cannot be predicted.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603221 | Project Number: 83
PE Title: Directed Energy Weapons | Budget Activity: 02

A. (U) RESOURCES ($ in Thousands)
Project Title: Support Programs

Popular Name:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Support Programs	21,610	46,894	27,059	17,274	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides funding for Army and Air Force program management and for completion of the Strategic Defense Facility at Sandia National Laboratory. The Army and Air Force funding covers expenses for civilian personnel, travel (TDY), training, rents, communications, information management, utilities, printing and reproduction, supplies, equipment, and contracts for research and support services. The Sandia funding will provide the equipment required to complete the facility.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) The funding provided to the services by this project enables them to centralize recurring operating costs so that funding for technical research may be devoted solely toward that purpose.

2. (U) The Sandia funding will complete this project, hence the decrease in the total funding for Project 83 from FY90 to FY91.

D. (U) WORK PERFORMED BY:

1. (U) Primarily the civilian employees of the Army Strategic Defense Command (Huntsville AL and Crystal City VA) and the Air Force Space Division (Los Angeles). Civilian personnel costs comprise 60% of the support programs funding provided to the services. Work is also performed by the following major contractors:

Integration Support, Ford Aerospace Division, Los Angeles (AF)
Systems Engineering Support, ANSER Inc., Los Angeles, (AF)
O&M for Simulation Center, COLSA Inc., Huntsville (Army)
Systems Engineering Support, GRC Inc., Huntsville (Army)
MIS Software Maint & Opns, Hewlett Packard, Hunstville (Army)

2. (U) The Sandia project was funded jointly by DoD and DOE at the direction of Congress. The work itself was performed by the DOE Albuquerque Operations Office through Sandia National Laboratories.

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY: Support programs have not been separately identified in previous submissions.

Program Element: #0603221 Project Number: 83
PE Title: Directed Energy Weapons Budget Activity: 02

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: N/A
2. SCHEDULE CHANGES: N/A
3. COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: Services submit detailed justification using SDIO Work Package Directive format to document each year's support program requirements.

G. (U) RELATED ACTIVITIES: Support programs funding for the Army and Air Force are also found in each of the other four SDIO program elements under Project 83.

H. (U) OTHER APPROPRIATION FUNDS: None

1. PROCUREMENT (Specify Appropriation): None

2. MILITARY CONSTRUCTION: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Budget Activity: 02 Advanced Technology Development

A. (U) RESOURCES: ($ in thousands)

Project Number & Title	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Tot Prog
30 Space Systems (U)	165,000	132,000	346,286	360,412	Continuing	
31 Exo KK Vehicle Systems (U)	116,000	202,255	244,225	293,819	Continuing	
32 Endo KK Vehicle Systems (U)	106,250	145,875	218,564	191,488	Continuing	
33 Advanced Weapons Tech (U)	117,582	89,105	217,673	311,507	Continuing	
34 Test and Evaluation (U)	133,105	68,015	107,137	145,665	Continuing	
35 Technology Support (U)	5,658	9,405	9,586	9,545	Continuing	
42 Theater Defense (U)	67,958	75,787	139,290	149,957	Continuing	
81 IS&T/SBIR (U)	23,365	21,702	41,277	49,190	Continuing	
82 Delta Star (U)	6,147	0	0	0	Completed	
83 Support Programs (U)	32,102	28,967	22,476	22,974	Continuing	
TOTAL FOR PROGRAM ELEMENT	773,167	773,111	1346,514	1534,557	Continuing	

B. (U) BRIEF DESCRIPTION OF ELEMENT: The kinetic energy weapons (KEW) program element is one of six established to implement the President's Strategic Defense Initiative and is concerned with the physical intercept and destruction of ballistic missiles and space-based weapons. These kinetic energy interceptors or projectiles may be guided or unguided, and launched by rocket boosters or alternate means such as hypervelocity guns. Both space-based and ground-based KEW concepts are investigated with the objective to identify, develop and demonstrate advanced kinetic energy technology and concepts. The KEW program includes the following research and research support areas:

1. (U) Space-based interceptor system using kinetic energy (non-nuclear) projectiles for ballistic missile or satellite defense.

2. (U) Ground-launched, exoatmospheric reentry vehicle interceptor subsystem.

3. (U) Ground-launched, high velocity, high endoatmospheric interceptor.

4. (U) Advanced weapons technology, including advanced hypervelocity rail gun development and light weight exoatmospheric projectiles.

5. (U) Test and evaluation support for all kinetic energy technologies.

6. (U) Technology support for allied and theater defense projects.

7. (U) Support technology covering basic research and all other aspects of administrative support associated with KEW systems.

FY 1990/1991 BIENNAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)
Project: 30
Budget Activity: 02 Advanced Technology Development (U)

Project Title: Space Based Interceptor Element (U)

PICTURE/SCHEMATIC ON THE NEXT PAGE

POPULAR NAME: SBI (U)

A. (U) SCHEDULE/BUDGET INFORMATION: ($ in thousands)

(U)SCHEDULE	FY 88	FY 89	FY 90	FY 91	To Complete
Program Milestones (X)	Robust Plume to Hardbody Algorithms complete. Contractor A Specs completed. New Threat incorporated. Mission. expanded in Midcourse. Program downscope. New SBI Element description.	New SBI Element A Specs. SDS Phase I interfaces defined. SBI subcomponent Hardware Development Started	XXXXXXXXXXXX XXXXXXXXXXX XXXXXXXXXXX	XXXXXXXXXXXX XXXXXXXXXX SBI subcomponent selected	DemVal completes in FY 94
Engineering Milestones (U)	Not an engineering program				
(U)T&E Milestones	Hover Test Facility Complete. Hardware-in-the-Loop Facility Complete. Flight Experiment test delayed due to budget reductions.	Hover Test of stability and control Ground Based Hardware test Heavyweight 1st & 2nd stage booster tests	Hover Test of improved subcomponent. Ground tests of improved subcomponents Hardware-in-the-Loop test of new seeker Lightweight 1st & 2nd stage booster tests.	Hover Tests of improved subcomponents Ground tests of improved subcomponents Hardware-in-the-Loop tests of Hit-to-Kill algorithms. Flight weight 1st & 2nd stage booster tests	Flight Tests Completed by early FY 94

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project: 30
Budget Activity: 02 Advanced Technology Development (U)

Contract Milestone (U)	Coherent Stop Work Issued.	Renegotiation of Contracts to New Funding	Technology Selection Negotiations	Flight Test Negotiations	New Competition in FY 93
BUDGET (U)	FY 88	FY 89	FY 90	FY 91	Prog Total
(U)Major Contract	118,000	88,000	239,286	248,412	Continuing
(U)Support Contract	31,000	13,000	42,000	44,000	Continuing
(U)In-House Contract	16,000	12,000	35,000	36,000	Continuing
(U)GFE/ Other	0	19,000	30,000	32,000	Continuing
(U) Total	165,000	132,000	346,286	360,412	Continuing

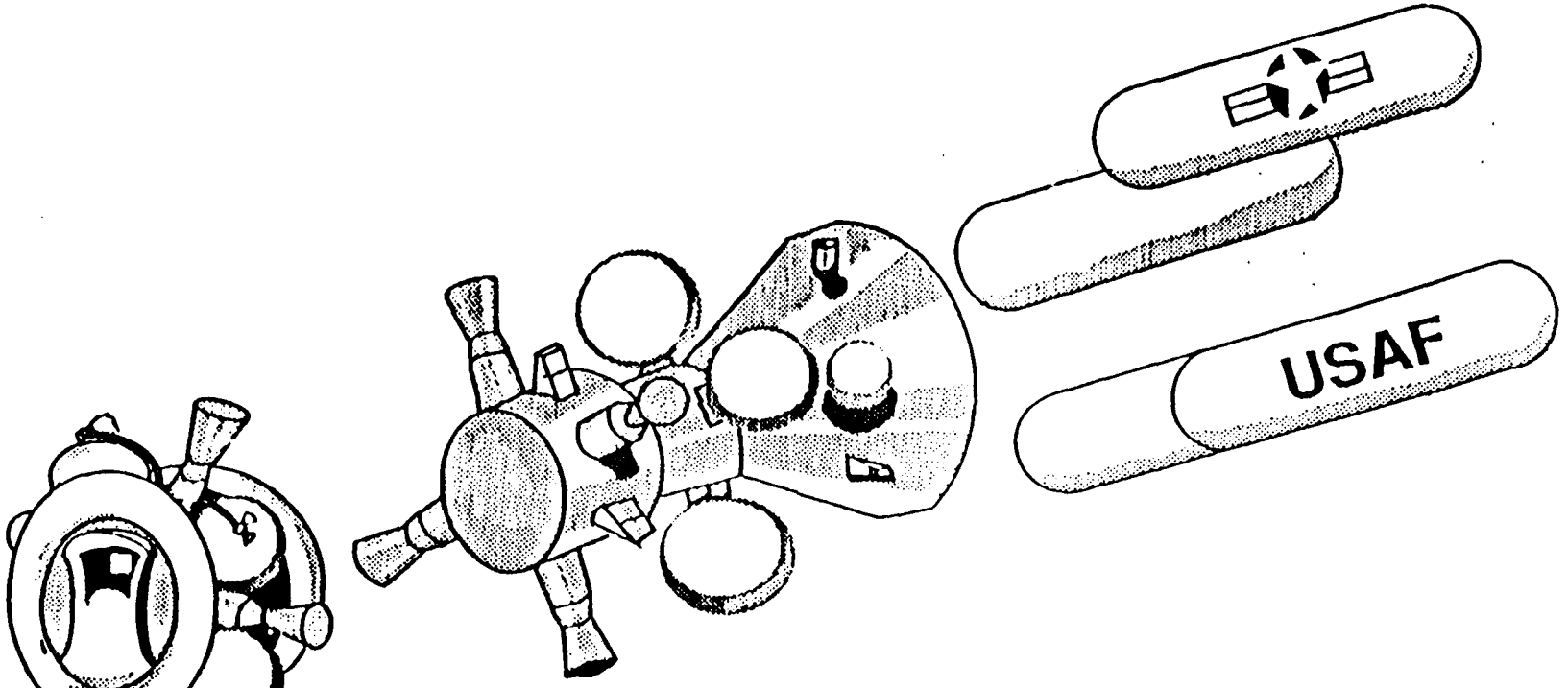
LEAP (See CDS Program Element #0603222C Proj #33-Task 02 KE Tech Base

	FY 88	FY 89	FY 90	FY 91	TO COMPLETE
SCHEDULE (U)	Most sub-systems of 3 & 5 Kgm projectiles complete.	Integrated projectiles development.	Integrated projectiles in ground test. Hover tests of 5 Kgm projectile.	New lighter weight sub-systems started Hover tests of 3Kgm projectile.	Continuing
FUNDING $ (U)	41,874	40,000	53,919	59,904	Continuing

Brilliant Pebbles (See CDS Program Element #0603221 Proj #25 Task 05

SCHEDULE (U)	Laboratory Hardware Development	Laboratory Hardware Tests	Flight Test Planned		
FUNDING $ (U)	30,100	11,950	9,985	6,988	

Space-Based Interceptor Artist's Concept



Program Element: 0603222C Project: 30
PE Title: Kinetic Energy Weapons (U) Budget Activity: 02 Advanced Technology Development (U)

B. BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
(U) The objective of the SBI project is to complete the Demonstration/Validation Phase for one of the two Weapon Elements in the Phase I Strategic Defense System (SDS). Besides working the interfaces with the other SDS Elements, the SBI project is developing demonstrating and validating the techniques and technology which will allow cost-effective interception of ballistic missiles from space. This project is divided into two tasks: 1) SBI Functional Technology Validation and 2) Space Based Technology Development. In addition, the SBI Element draws on concepts and technology being developed by the Air Force and Army LEAP programs and by the LLNL Brilliant Pebbles program. Those three programs are developing very light weight subcomponents and investigating operational concepts that could greatly decrease the cost of a space based interceptor. In addition, these programs provide competition to keep the mainline SBI contractors moving forward as fast as possible.

1. (X) Subtask 1: SBI Functional Technology Validation.

The SBI Element must be able to engage boosters, post-boost vehicles, reentry vehicles and anti-satellite weapons when viewed against space, earth and nuclear backgrounds. It receives battle management, weapons release and threat track data from other SDS Elements through communication links on BSTS and SSTS to the carrier vehicle (CV). The CV provides maintenance services to the interceptors until the command to launch is given. The CV also has a number of survivability functions XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX The interceptor receives threat track information XXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXX The interceptor's seeker acquires the threat and guides the projectile (interceptor first stage) into position for an intercept. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX The SBI Element technical requirements have been reduced to a minimum by relying on other SDS Elements and by exploring the major technology advances that SDIO has achieved.

2. (U) Subtask 2: Space Based Technology Development.

This subtask focuses on the development of very light weight, highly efficient propulsion units for the 1st and 2nd stages of the SBI interceptor. To maintain competition, the baseline design has a solid first stage and liquid second stage. That baseline could change as hardware test data becomes available. This work was originally funded by Project #33 - Advanced Weapons Technology, PE #0603222C -Kinetic Energy Weapons.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) Prior Year (FY 1988) Accomplishments.

a. (U) Subtask 1: SBI Functional Technology Validation.
- (U) Robust plume-to-hardbody algorithms for booster interceptor complete.
- (U) Lightweight 60 Ghz receiver complete.
- (U) Hover Test Facility Operational.
- (U) Lightweight IMU Breadboard Complete.
- (U) Lightweight Divert Engine Tested.

- o (U) Z-Plane processor for (earth/nuclear background rejection).
- o (U) Government Hardware-In-The-Loop Simulator Operational.

2. (U) Current Year (FY 1989) Plan.

a. (U) Subtask 1: SBI Functional Technology Validation.

- o (U) Develop New SBI Element Description
- o (U) Hover Tests of Stability and Control Algorithms
- o (U) Ground Based Hardware Tests
- o (U) Ultra Lightweight IMU Technology Demonstrated

b. (U) Subtask 2: Space Based Technology Development.

- o (U) Heavyweight Liquid Axial Engine Tests
- o (U) Heavyweight Solid Axial Engine Tests

3. (U) Budget Year (FY 1990/1991) Plan.

a. (U) Subtask 1: SBI Functional Technology Validation.

- o (U) Conduct Integrated Technology Improvements.
- o (U) Perform Ground Based Hardware Tests.
- o (U) Select Best Interceptor Technology.
- o (U) Improve Liquid Axial Engine Performance.
- o (U) Improve Solid Axial Engine Performance.
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
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- o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

4. (U) Program Plan to Completion. This is a continuing program.

D. (U) WORK PERFORMED BY:

1. (U) Subtask 1:

- o (U) SCIT - Rockwell, Downey, CA; Martin Marietta, Denver, CO.
- o (U) KHILs - AFATL, Eglin AFB, FL.

2. (U) Subtask 2:

- o (U) Aerojet, Sacramento, CA; Morton-Thiokol, Elkridge, MD.

Program Element: 0603222C Project: 30
PE Title: Kinetic Energy Weapons (U) Budget Activity: 02 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(X) TECH	XXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXX XXXXXXXXXXXX	Reduces Competition
(U) SCHED	Reduces Risk	Maintain	Slows Program
(U) COST	Reduces Cost	Reduces Cost	Increases Final Cost

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (X) TECHNICAL CHANGES: The SBI Element was modified XXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX as well as to XXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX These changes could be made by shifting those functional responsibilities to the XXXXXXXXXXXXXX with minimal impact on their design. The SBI Element modifications also made it possible XXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXX The Flight Experiment was delayed until FY 92 in anticipation of a Congressionally mandated budget ceiling. When that did not occur, too much of the work force had already been lost. A more capable flight experiment is now planned in FY 92 using integrated technologies from LEAP, Brilliant Pebbles or SBI contractors.

2. (X) SCHEDULE CHANGES: The XXXXXXXXXXX in SBI Element capabilities and the down-select between competitive technologies allows the FSD Milestone in FY 94.

3. (U) COST CHANGES: The FY 1989 funding reduction was $169M.

F. (U) PROGRAM DOCUMENTATION: Defense Acquisition Board Milestone I Report for the Phase I Strategic Defense System. Test and Evaluation Master Plan (TEMP).

G. (U) RELATED ACTIVITIES: SBI receives technology support from the following program elements: PE 0603220C - Surveillance, Acquisition, Tracking and Kill Assesment; PE 0603221C - Directed Energy Weapons; PE 0603222C - Kinetic Energy Weapons; and PE 0603224C - Survivability, Lethality and Key Technologies. Projects within these program elements include propulsion, hardened sensor and hardened electronics, booster plume phenomenology, coherent laser radar, space power, survivability, lethality, hardened optics and optics control, LEAP, and Brilliant Pebbles.

H. (U) OTHER APPROPRIATION FUNDS:

1. (U) PROCUREMENT: None.

2. (U) MILITARY CONSTRUCTION: Included in program summary.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) TEST AND EVALUATION DATA: Not applicable to this program.

FY 1990/1991 BIENNAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 31
Budget Activity: 02 Advanced Technology Development (U)

Project Title: Ground-Based Exoatmospheric Interceptor Development

PICTURE/SCHEMATIC DIAGRAM (X)
(ON NEXT PAGE)

POPULAR NAME: Ground-Based Interceptor(GBI)/Exoatmospheric Reentry Vehicle Interceptor Subsystem (ERIS)

A. (U) SCHEDULE/BUDGET INFORMATION: ($ in Thousands)

(U)Schedule	FY 88	FY 89	FY 90	FY 91	To Complete
Program Milestones (U)	FTV CDR TEMP Developed.	Flight HDW delivered to USAKA	FTV Program Completed	ATV Flight HDW delivered to USAKA	Continuing
Engineering Milestones (U)	FTV Air Vehicle Design Complete.	Flight HDW Fabrication & Delivery	Integraton of Advanced Technologies	Refinement of GBI FSD Requirements	Continuing
(U)T&E Milestones	USAKA Construction	ISTV, HWIL Testing	FTV Flight Test Series	ATV Flight Test Series	Continuing
Contract Milestones (U)	FTV Contract Restructured	ATV Contract Final	FTV Contract Effort Ended	GBI FSD RFP Prepared	Continuing
(U)BUDGET	FY 88	FY 89	FY 90	FY 91	Prog Total
(U)Major Contract	115,000	153,255	187,225	227,819	Continuing
(U)Support Contract	7,000	12,000	13,000	15,000	Continuing
(U)In-House Contract	7,000	30,000	34,000	39,000	Continuing
(U)GFE/ Other	7,050	7,000	10,000	12,000	Continuing
(U)Total	116,000*	202,255	244,225	293,819	Continuing

*An additional 20,050 carried in Project 33 of this Program Element was applied to this project in FY88 only for an FY88 total of 136,050.

Program Element: 0603222C Project: 31
PE Title: Kinetic Energy Weapons (U) Budget Activity: 02 Advanced Technology Development (U)

B. <u>(U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES</u>:

(X) The objective of the ground based exoatmospheric interceptor (GBI) development effort is to develop, demonstrate, and validate the techniques and technology to allow cost-effective intercept of ballistic missile reentry vehicles prior to their reentry into the atmosphere. The concept is a ground-launched exoatmospheric interceptor designed for hit-to-kill (non-nuclear) intercepts of intercontinental ballistic missile's (ICBM) and submarine launched ballistic missile's (SLBM) reentry vehicles (RVs) in the midcourse of their trajectories. The GBI will be integrated with the midcourse sensor system through a Command Center element. The midcourse sensors will acquire, track, and pass target information to the interceptors. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXX The performance characteristics are summarized in the figure below.

ERIS Development is separated into three tasks: 1). ERIS Demonstration and Validation (Dem/Val), 2). GBI Concept and Technology Integration, and 3). Advanced Exoatmospheric Interceptor Technology Development.

(U) 1. TASK 1. ERIS Dem/Val: ERIS is conducting a series of 7 to 8 exoatmospheric interceptor experiments to demonstrate and validate the concept of a low-cost, ground-launched ballistic missile defense interceptor. (3-4 FTV, 4 Advanced Technology Validation (ATV)).

(U) 2. TASK 2. Ground-Based Interceptor: The GBI Concept and Technology Integration (CTI) will develop one or more baseline designs to prepare for entry into Full-Scale Development. Hardware proposed for GBI will be selected for Dem/Val and Flight Test on the ERIS ATV flight series.

(U) 3. TASK 3. Advanced Exoatmospheric Technology Development. This task develops advanced technologies for resolution of critical issues for Phase I and more advanced interceptors. For example, sensor technology efforts are being pursued which include passive and active seekers, and technologies such as cooled optics, and advanced focal planes. Fire control technology efforts include devices such as miniature fuzing lasers, and hardware/software for reduced computer complexity. The guidance and control effort includes inertial devices and electronics that are both lightweight and low cost. A miniature hit-to-kill vehicle technology is being developed with emphasis on reduction in size and weight.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) Prior Year (FY 1988) Accomplishments:

a.(U) Task 1: ERIS Dem/Val:
- (U) Functional Technology Validation (FTV) program Critical Design Review (CDR) completed in July.
- (U) The Air Vehicle (AV) design was completed.
- (U) A Test and Evaluation Master Plan (TEMP) was updated.
- (U) Sensor Test Facility (STF) was completed.
- (U) The 3-axis motion simulator with scene generator was installed.
- (U) The prototype IR Seeker and Inertial Measurement Unit (IMU), were delivered.

- (U) Testing was conducted on the Propulsion and Reaction Control System (P&RCS) to evaluate nozzle alignment effects, threat erosion effects due to high duty cycle operation, and the performance of the fast-acting fuel-feed shut-off valve.

b.(U) Task 2: GBI: Commenced in FY 89 to prepare for the required competition for Full-Scale Development.

c.(U) Task 3: Advanced Exoatmospheric Technology Development.
- (U) Continued development of a small, light-weight low-cost IMU utilizing a resonant fiber optic gyroscope (RFOG) with

associated solid-state accelerometers and electronics.
- (U) Continued development of a high speed parallel processor utilizing VHSIC/VLSI technology. Work on the development of a new High Speed, RISC, Hardened CMOS/SDS Vector Processor started.
- (U) Discrimination research was begun, investigating the potential pay-off from increasing the IR bandwidth of the GBI seeker and adding a visible and/or ultraviolet sensing capability.
- (U) Two staring Focal Plane Array (FPA) technology efforts began, both expected to yield a full-staring, multicolor, high yield and high element-to-element uniformity FPA. One of the two (Advanced Focal Plane Array) proposes a reliable low-cost manufacturing for FPA elements.

2. (U) Current Year (FY 1989) Plan:

a.(U) Task 1: ERIS Dem/Val:
- (U) Four seeker assemblies to be delivered and seeker testing completed.
- (U) Flight version avionics packages to be delivered and testing begun.
- (U) Contractor subsystem HWIL testing to be conducted.
- (U) ISTV model testing to be conducted.
- (U) EMI/EMC testing to be conducted.

b.(U) Task 2: GBI Development: Contracts will be awarded for advanced interceptor concepts.
- (U) Independent government testing of advanced technologies components will begin with the intent of supporting FSD design requirements.

c.(U) Task 3: Advanced Exoatmospheric Technology Development:
- (U) Technology efforts will continue with the goal of providing prototype hardware for the ATV flights.
- (U) Commence solving the technical issues of integrating the LEAP seeker in the ATV flight vehicle.

3. (U) Budget Year (FY 1990/1991) Plans:

- (U) KV model testing will be conducted.
- (U) Flight software package will receive final certification.

Development (U)
- (U) Test flights FTV #1, #2, #3 will be conducted.
- (U) Conduct flight test ATV #1.
- (U) Continue detailed planning for remaining ATV missions (ATV #2, #3, and #4).
- (U) Begin development of a system specification for the GBI to enter FSD.
- (U) LEAP seeker hardware will be procured to support ATV integration.
- (U) Advanced processor hardware will be procured to support ATV

- (U) Begin selection of the technologies to support GBI FSD.

4. (U) Program Plan to Completion: This is a continuing program. Dem/Val is expected to extend through FY92 followed by FSD beginning in FY93.

D. (U) WORK PERFORMED BY:

1. (U) Task 1:

- (U) Lockheed Missile and Space Company, Sunnyvale, CA.
- (U) Texas Instruments, Dallas, TX.

2. (U) Task 2: To Be Determined

3. (U) Task 3:

- (U) Hercules, Bacchus, UT.
- (U) Georgia Institute of Technology, Atlanta, GA.
- (U) Draper Laboratories, Boston, MA.

- (U) Hughes, Canoga Park, CA.
- (U) Phillips Components, Southhampton, UK.

E. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY:

1. (U) The Task 1 program was restructured to reflect a funding reduction of $60 million in FY88. The original program of $177M included the procurement of five sets of missile hardware for experimental flights, dual source seekers with down-select at month 42. The restructured program purchased missile hardware for only three FTV test flights with options for one additional flight. One of the seeker contractors was terminated. These actions added some additional risk to the FTV program. The ATV test series has been added to take advantage of the Government's investment in the FTV and Advanced Technology Development.

2. (U) Task 2, GBI development, was established to prepare for full and open competition for FSD.

3. (U) The Task 3 program in general remains the same. However, schedules were slipped essentially a year due to budget constraints.

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) TECH	Higher	No change	Reduced
(U) SCHED	Slipped	Slipped	Reduced
(U) COST	Stretched	Restructured	Reduced

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: No technical changes were made to the FTV design. The schedule slip allows for testing of more advanced technologies into the ATV Flight Test Series.

2. (U) SCHEDULE CHANGES: The first FTV flight, which was a launch and kill vehicle checkout only, has been cancelled and the second and third flights accelerated by six months.

3. (U) COST CHANGES: Overall program cost has increased.

F. (U) PROGRAM DOCUMENTATION: Defense Acquisition Board System Concept Paper (SCP), Test and Evaluation Master Plan (TEMP), and cost related documents.

G. (U) RELATED ACTIVITIES: None

H. (U) OTHER APPROPRIATION FUNDS: N/A

1. (U) PROCUREMENT : None
2. (U) MILITARY CONSTRUCTION: Included in program summary.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) TEST AND EVALUATION DATA: Not applicable to this program.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons Technology Development
Project Number: 32
Budget Activity: 02 Advanced

A. (U) RESOURCES: ($ in Thousands)
Project Title: Endo Non-Nuclear-Kill Test Bed-High Endoatmospheric Defense Interceptor (HEDI) (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
HEDI						
Subtask 1 HEDI:	106,250	115,000	168,641	116,610	Continuing	
Subtask 2 Endo Tech:	10,864*	30,875	49,923	74,870	Continuing	
Total:	106,250	145,875	218,564	191,488		

* FY88 funding for Subtask 2 is actually included in Project 33 totals.

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(X) Subtask 1: The High Endoatmospheric Defense Interceptor (HEDI) operates against the terminal phase of attacking ballistic missiles. It is designed to engage leakers from the midcourse phase, depressed submarine-launched ballistic missile (SLBM) or intercontinental ballistic missile (ICBM) attacks intended to underfly a midcourse system, and SLBM attacks with times of flight that are insufficient for a midcourse engagement. The HEDI Baseline Technology Interceptor (BTI) is a passive infrared seeking, XXXXXXXXXXXXXXXXXXh hyper-velocity non-nuclear warhead XXXXXXXXXX with large XXXXX maneuver and divert XXXXXXXXXXXX capabilities. XXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX The HEDI BTI can be launched with either exo or endo-atmospheric acquisition sensors through the battle manager. It is inertially guided and can be updated in flight. The HEDI program is characterized by a Kinetic Energy Kill Vehicle Integrated Technology Experiment (KITE) with the objective of resolving five categories of key technical issues through intensive ground and preliminary flight tests that lead to a successful intercept of a representative RV target at White Sands Missile Range. The KITE phase will then provide the basis for the more stressing flight tests at USAKA leading to the Baseline Technology interceptor for application in the high endoatmospheric regime.

(X) Subtask 2: The objective of Endoatmospheric Technology development effort is to infuse evolving technologies into the development of the Baseline Technology Interceptor or its advanced successor. Advances in the state-of-the-art are being pursued in such technologies as passive infrared and active millimeter wave seekers; optical windows and radomes; XXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX; dense, high burn rate liquid gel and solid propellents; improved avionics and guidance systems; and advanced high strength ceramic and metallic composites. Technology developed under this project is also expected to apply to concepts which address the defense of our Allies.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

a. (U) Subtask 1, HEDI:

o (U) The first construction of a full hybrid detector array was completed and thermally tested (Nov 87).

o (U) The first brassboard laser range-finder was tested and delivered.
o (U) The nosetip thermal test validating the platelet cooling in an arcjet was completed (Oct 87).
o (U) Delivered the first full size sapphire window of optical quality. Subsequent deliveries have continued.
o (U) Conducted successful final firing of the full scale warhead in an arena test (Aug 88). This completes the warhead tests.

b. (U) Subtask 2, Endoatmospheric Technology Development:
o (U) The Brassboard Optical Advanced Seeker Technology (BOAST) designs were completed.
o (U) A full scale transpiration cooled metallic radome was designed and developed as a component to an alternate seeker for endo atmospheric interceptors.

2. (U) FY 1989 Planned Program:

a. (U) Subtask 1, HEDI:
o (U) Conduct the first flight experiment at White Sands Missile Range Called KITE -Kinetic Kill Vehicle Integrated Technology Experiment. This first flight objectives will verify the modified Sprint propulsion system, first and second stages separation, the validation of the air vehicle configuration, kill vehicle shroud separation and separation from the booster stages, measure the kill vehicle forebody environment, characterize the window cooling performance with an instrumented plate and exercise the warhead (3Q89).
o (U) Conduct a full-scale model test in NSWC-9 wind tunnel to validate the image blur and boresight error prediction models (2Q89).
o (U) Conduct jet interaction performance tests of the flight weight thrusters for response time and thrust at AEDC-B (2Q89).
o (U) Delivery of the KITE-2 and KITE-3 seekers and KITE-3 laser range finder.

b. (U) Subtask 2, Endoatmospheric Technology Development:
o (U) Development of a staring array, short wave infrared, seeker will be initiated with radiation hardening emphasized.
o (U) A laser diode will be developed to provide fuzing and tracking ranging functions.
o (U) A high pressure, high burn rate motor program will begin for an out-year test vehicle.

3. (U) FY 1990/1991 Planned Program:

o (U) Deliver full seeker, laser, and control hardware for KITEs 2 and 3.
o (U) Coordinate KITE 2 flight experiment to track representative target in IR mode.
o (U) Conduct KITE-3 intercept of a representative RV target at WSMR with the full up kill vehicle (3Q91).

o (U) Develop and design advanced propulsion system for booster requirements.
o (U) Begin baseline definition and design for operational interceptor.
o (U) Complete the BOAST seeker database for inclusion in the BTI program.
o (U) Begin research and development of Resonant Fiber Optic Gyro (RFOG) Inertial Measurement Unit (IMU).

4. (U) Program to Completion: This is a continuing program.

(U) Work Performed By:

a. (U) Subtask 1: HEDI.

o (U) McDonnell Douglas Corp (Prime), System Integration, Kill Vehicle Airframe and Air Vehicle Integration at Huntington Beach, CA.
o (U) Hughes Aircraft Company (Sub), Kill Vehicle Seeker, Integration and Avionics at Canoga Park, CA.
o (U) Aerojet Tech Systems Company (Sub), Propulsion Controls, Forebody and Window Cooling at Fulsom, CA.

b. (U) Subtask 2: Endoatmospheric Technology Development.

o (U) General Electric at Valley Forge, PA.
o (U) Hercules at Magna UT.
o (U) Litton at Los Angeles, CA.
o (U) John Hopkins University at Baltimore, MD.
o (U) Rockwell International, Los Angeles, CA.
o (U) Rexham at Huntsville, AL.

E. (U) COMPARISON WITH FY 1988/1989 DESCRIPTIVE SUMMARY:

(U) The program objectives remain the same as described in FY88 with the exception that several tests scheduled for FY88 (NSWC Window Aero-optics and Colling evaluations, and AEDC Forebody Survivability-High Temperature test) have been deferred to FY90 in order to align with the FY88 funding decrements. In order to increase the system confidence prior to going on to the USAKA BTI flight tests, a KITE-4 option has been incorporated into the program plan. The endo technology has been refocused in portions to meet the new BTI requirements.

Program Element: 0603222C
PE Title: Kinetic Energy Weapons Technology Development

Project Number: 32
Budget Activity: 02 Advanced

IMPACTS OF CHANGES

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
TECH (Forebody/ Air Vehicle)	Objectives remain same	Slipped	As programmed
SCHED	Flts reduced to 3 Higher risk	Slipped Restructured	As programmed
COST	No change	N/A	As programmed

NARRATIVE DESCRIPTION OF CHANGES

1. (U) TECHNICAL CHANGES: The technology objectives for the KITE phase The FTV flight test program has been replaced with the BTI advance of the FTV program which maintained the same heavy, large kill vehicle in its tests. The BTI phase of the program will realize the downsized, light weight KV for early application in the SDS follow-on phase.

2. (U) SCHEDULE CHANGES: Stopped the development of the thrusters work. Slipped the first and second KITE flight test by 5 months respectively. Eliminated the FTV flight tests and programmed the BTI flight tests in their place. Delayed completion of seeker hardware until FY 1989. Deleted Aero Thermal structures program.

3. (U) COST CHANGES: Funding level estimate remains the same.

F. (U) PROGRAM DOCUMENTATION:

HEDI Endoatmospheric Defense Interceptor (HEDI) Subsystem Functional Technology Validation (FTV) Requirements Document, 17 April 1985
HEDI Concept Definition, April 1985
Prime Item Development Specification for HEDI FTV Subsystem, 10 October 1986, MDAC CDRL No. AE09.
HEDI System Concept Paper, 16 June 1987
HEDI Operational Concept Study, October 1987
HEDI Brief to the Defense Acquisition Board, Strategic Systems Committee, 23 August 1988.

G. (U) RELATED ACTIVITIES:

(U) A second Aerothermal Reentry Vehicle Experiment will be conducted during FY90 to continue characterizing the aerothermal demise of an RV after being intercepted by a kinetic energy vehicle. The HALO and IRIS aircraft with optical packages will participate in collecting spectral data during known test launches to continue building the signature database for HEDI. A target hit indicator effort will be initiated to provide on board damage assessment data for the HEDI RV targets.

H. (U) OTHER APPROPRIATION FUNDS:

1. (U) PROCUREMENT: None

2. (U) MILITARY CONSTRUCTION: $2.4 Million in 1990 for MPS-36 Radar Tracking Facility at Kwajalein Missile Range to provide range safety.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS:

(U) British Aerospace, UK, is providing the KITE kill vehicle gyroscope under subcontract to McDonnell Douglas.

J. (U) MILESTONE SCHEDULE:

- (U) WSMR KITE Flight II - 2Q90
- (U) WSMR KITE Flight III - 2Q91

FY 1990/1991 BIENNAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment (U)
Project: 09
Budget Activity: 2 Advanced Technology Development (U)
Project Title: Midcourse Demonstration/Validation (U)

PICTURE/SCHEMATIC ON THE NEXT PAGE

POPULAR NAME: Midcourse Demo/Val (U)

A. (U) SCHEDULE/BUDGET INFORMATION: ($ in thousands)

(U)SCHEDULE	FY 88	FY 89	FY 90	FY 91	To Complete
Program Milestones (U)					Continuing
Engineering Milestones (U)		SSTS SRR GSTS SRR	SSTS SDR GSTS SDR	GSTS PDR	Continuing
(U)T&E Milestones					Continuing
Contract Milestones (U)	GSTS Contract Award	SSTS Option Award	GSTS Sensor Subcontractor Down select		
(U)BUDGET	FY 88	FY 89	FY 90	FY 91	Prog Total
(U)Major Contract	26,154	92,662	134,745	270,458	Continuing
(U)Support Contract	5,459	3,209	4,174	5,201	Continuing
(U)In-House Contract	6,133	12,085	24,835	39,157	Continuing
(U)GFE/ Other					
(U)Total	37,746	107,956	163,754	314,816	Continuing

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 33
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in thousands)

Project Title: Advanced Weapons Technology (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
KE Tech Base	117,582	89,105	217,673	311,507	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project will develop, integrate, demonstrate, and validate the technologies required for all layers of ground and space based ballistic missile defense. The project is divided into four subtasks: 1. Component Technology, 2. Integration Technology, 3. Functional Validation Technology, and 4. Alternative Launch (Hypervelocity) Technology.

1. (U) The component technologies cover seekers, avionics, inertial measurement units, divert control, axial propulsion, fire control and communications.

2. (X) The integration technology goal is to produce small, lightweight XXXXXXXXXXXXXXXXXXXXXXXX weapons grade projectiles.

3. (U) The functional validation technology projects are an integrated program of digital emulation, hardware in the loop, controlled ground hover testing and a focused program of free flight kinematrics demonstrations to validate the performance of integrated components and pull up kinetic kill vehicles. This project provides the government an independent assessment capability i . evaluating new technologies, predicting interceptor performance utilizing the new technologies, and improving confidence in mission accomplishment of system element concepts through hardware validated simulation.

4. (X) The alternative launch technology projects will develop, integrate and demonstrate technologies (power rail guns, switches, armatures) required for ballistic missile defense using hypervelocity guns. This area also examines the feasibility of launching small pellets and plasma particles at extremely high velocities XXXXXXXXXXXXXXXXXXXXXXXXXX in order to provide balloon and decoy discrimination in the midcourse.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) Prior Year (FY 1988) Accomplishments:

(U) Subtask 1: Component Testing

o (U) Developed an ultra violet (UV) seeker breadboard to capitalize on data from Delta 180 and 181.
o (U) Transi :n the resonant fiber optic gyro (RFOG) to industry for initial prototype builds.

(U) Subtask 2: Integration Technology

o (U) Most subsystems of the three and five kilogram space-based projectiles were completed and passed latest board checks.

o (U) A very light laser optics IMU was integrated surpassing requirements.

o (U) An endoatmospheric miniature projectile program was strengthened during the year to augment the endoatmospheric component program.

(U) Subtask 3: Functional Validation Technology

o (U) Installation of the computer suite to perform hardware in the loop testing was completed

o (X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXX

o (U) Static firing of a hover test platform (KHIT) was successfully controlled using advanced software techniques.

(U) Subtask 4: Hypervelocity Launchers:

o (U) Completed high power 200 megajoule test facility

o (U) Initiated firing of various hypervelocity guns in the 200 megajoule facility

o (U) Continued small pellet and plasma particle research through launching .01 grams to 50 km/sec

o (U) Solid State switching and High Temperature Superconductor parts will be fabricated and tested.

(U) <u>Current Year (FY1989) Plan</u>:

(U) Subtask 1: Component Technology:

o (U) Develop fast frame (1000 frames/sec) seeker using Z plane technology and hot superconducting electronics.

o (U) Complete fabrication of the heavyweight and propulsion booster for SBI.

(U) Subtask 2: Integration Technology:

o (U) Flight test program planning for these projectiles will begin during this period

o (U) Concept work on endoatmospheric projectiles will reach the design state.

(U) Subtask 3: Functional Validation Technology

o (U) Initiate procurements to advance in-band infrared scene projection

technology for both hardware in the loop and ground hover testing

Program Element: 0603222C | Project Number: 33

PE Title: Kinetic Energy Weapons (U) | Budget Activity: 02 Advanced Technology Development (U)

(U) Subtask 4: Hypervelocity Launchers

o (U) Work will begin in the design of a proto-typical test bed for the 200 megajoule hypervelocity guns.

o (X) A high muzzle energy XXXXXXXXXXXXXXXXXXX gun effort will be initiated

o (U) Fire I Phase II testing will be complete with rapid fire testing at 2 Megajoule/shot levels

(U) Budget Year (FY 1990/1991) Plans:

o (U) All LEAP programs will be complete with ground and captive (ground-based) hover test validating projectile performance via the test and evaluation equipment developed in subtask 3.

o (U) The endo guided projectile program will begin brassboard component development on projectile and fire control component

o (U) Tier II barrel fabrication will be initiated

(U) PROGRAM PLAN TO COMPLETION: This is a continuing program

D. (U) WORK PERFORMED BY:

o (U) Boeing Aerospace Co. (Prime) Projectile design, fabrication and integration and test. Kent, WA

o (U) Hughes Missile Systems Group design fabrication integration and test, Conoga Park, CA

o (U) General Electric, design and component test, Valley Forge, PA

o (U) IAP Research switch barrel and inductor fabrication armative development, Dayton, OH

o (U) GA Technologies Inductor fabrication thermal management barrel development, San Diego, CA

o (U) Maxwell Laboratories, armature development San Diego, CA

o (U) University of Texas Power supply development, Austin, TX

o (U) Georgia Tech University, Atlanta GA, parallel processors, digital emulators

o (U) Integrated Systems Corporation, Lost Angeles, CA will proceed with scene projection in real time

o (U) Rocketdyne, Los Angeles, CA will produce work horse divert propulsion hover vehicle

o (U) Space Vector Corporation, Los Angeles, CA will develop data acquisition package concepts for the Kinematic experiments.

E. (U) COMPARISON WITH FY1988/1989 DESCRIPTIVE SUMMARY:

o (U) FY1988 objectives were partially met due to lower than expected funding. Objectives were not met in projectile integration.

o (U) Battery Power Facility (BPS) exceeded its technical goals by 10%. Rapid fire testing will be initiated in FY1989.

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 33
Budget Activity: 02 Advanced Technology Development (U)

o (U) The diverse technology validation efforts were integrated with technology development programs to ensure there were no duplicative efforts. A long range functional validation program was developed.

IMPACT OF CHANGES

CHANGE		SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
TECH	Subtask 1	Objectives Remain Same	Slipped 6 mo	As programmed
	Subtask 2	Objectives Remain Same	Slipped 9-12 mo	As programmed
	Subtask 3	Objectives as stated	Paralleled to gain 3 mos	As programmed
	Subtask 4	Objectives Remain Same	Slipped 12 mo	As programmed
SCHED	Subtask 1	No Change	N/A	As programmed
	Subtask 2	Fire Control Expt FTP Design	Deleted/Delayed As programmed	
	Subtask 3	Ground Test Objectives	As Scheduled	As programmed
	Subtask 4	Demonstration	Delayed 2 Years	
COST	Subtask 1	Components	Slipped to FSD	Increased $16M
	Subtask 2	Projectile	Restructured	Increased $10M
	Subtask 3	Test Objectives	Delayed	Increased $27M
	Subtask 4	Demonstration	Delayed	Increased $10M

1. (U) TECHNICAL CHANGES:

(U) Subtask 1: Fire Control work transitioned to BSTS and SSTS

(U) Subtask 2: The reduced budget deletes the fire control experiment and delays delivery of the Ground Test Projectile (GTP). Although the GTP will meet technical objectives, cost will increase due to program stretch out.

2. (U) SCHEDULE CHANGES:

(U) Subtask 1: Component maturity will miss FSD if not funded
(U) Subtask 2: FTP delayed 9-12 months. GTP delayed 9-12 months. Fire control experiment deleted.
(U) Subtask 3: Schedule delayed until GTP delivered

3. (U) COST CHANGES:

(U) Subtask 1: Overall cost increase of $16M to meet FSD support.
(U) Subtask 2: Overall cost increase of $10M.
(U) Subtask 3: Overall cost increase of $23M required to meet objective

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 33
Budget Activity: 02 Advanced Technology Development (U)

F. (U) PROGRAM DOCUMENTATION:

LEAP Technical Requirements Letter	Feb 1987
Terminal Defense HVG Study	Feb 1988
Advanced Gun Study	Apr 1987
Testing Facility Study	Aug 1988

G. (U) RELATED ACTIVITY: The Space-Based Interceptor (SBI) and Exoatmospheric Reentry Interceptor Subsystem (ERIS) programs are jointly coordinating the functional technology validation efforts with the LEAP Program. The LEAP program is the pathfinder for the efforts to calibrate test facilities primarily in support of the SBI program. The ERIS program is coordinating use of LEAP projectiles for advanced technology flights and ground based interceptor (GBI).

H. (U) OTHER APPROPRIATION FUNDS:

1. (U) PROCUREMENT: None

2. (U) MILITARY CONSTRUCTION:
   - (U) Power conditioning Facility $.419M, FY88, Eglin AFB, FL.
   - (U) Experimental Support Facility $1.1M, FY88, Eglin AFB, FL.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS:

- (U) Cooperative EML Research with the Netherlands (MOA)
- (U) Cooperative HVG Research with the United Kingdom (MOA)

J. (U) MILESTONE SCHEDULE:

(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXX
(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX
(X) XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 34
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in thousands)

Project Title: Test and Evaluation (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
T&E	133,105	68,015	107,137	145,665	Cont	Cont

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(U) The test and evaluation project within Kinetic Energy provides specialized data collection and technology development not covered under other projects and provides generic test range improvements and target developments and presentation for all of the Kinetic Energy experiments. The KEW optical diagnostics program develops airborne optical data recording platforms using a Lear 35 and a NC-135A to support SDIO data and photo documentation requirements on rocket plumes, re-entry vehicles and kill assessment. JANUS is a cooperative program between SDIO and the Navy using Trident C-4 missiles carrying SDIO space experimental payloads. US Army Kwajalein Atoll (USAKA) Missile Range instrumentation and SDI targets provide flight safety, communications, operations control, telemetry and timing for the tests to be performed at the range. The targets program develops, fabricates and delivers targets for kinetic element testing. The Strategic Target System (STARS) is a program using refurbished Polaris A-3 missiles to provide dedicated boosters for SDIO test flights into the USAKA test range. Multinational test support is a cooperative program between SDIO and foreign countries that collects phenomenology data on rocket plumes, kill assessment and re-entry vehicles.

C. (U) PROGRAM ACCOMPLISHMENT AND PLANS:

(U) FY1988 Program:

- o (X) Delta 181 collected approximately 47 gigabits of data to XXXXXXXX XXXXXXXXXXXXXX.
- o (U) The Lear and NC-135A provided support to Project Verify, Delta-181, Red Gemini and the Navy D5 Project
- o (X) JANUS SDIO experimental payloads were made ready for mission 1 prime XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX.
- o (U) Mission concept studies, trajectory development, and initial designs were completed for JANUS 1b and 2.
- o (U) A joint SDIO and Strategic Defense Systems Program technical feasibility and cost analysis for JANUS mission 2 was initiated.
- o (U) The USAKA installed 80% of the GPS ground stations, and initiated work on telemetry, communications, and optical systems for the ERIS and HEDI flight test demonstrations.
- o (X) Two inter-nation optical aircraft cooperative missions were completed. XXXXXXXXXXXXXX data was obtained using instrumentation from the ARGUS aircraft.

o (U) STARS ground testing was successfully completed. Fabrication of the targets for ERIS and HEDI was started along with procurement of boosters and release assemblies.

(U) FY 1989 PLANNED PROGRAM:

o (X) The development and fabrication of experimental target payloads for a joint [U.S./U.K.] mission scheduled for XXXXXXXXXXX will begin. This will provide XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX. [Three] joint missions are planned to obtain additional [plume] data in the boost phase.

o (U) Data reduction of Delta 181 will be completed in January 1989.

o (U) Both optical aircraft will receive minor systems upgrades including a UV sensor for Lear and a LWIR sensor for NC-135A.

o (X) JANUS mission 1 prime will be launched XXXXXXXXXXXXX followed by post mission data reduction and analysis.

o (X) Mission 2 technical feasibility and cost evaluation will be completed. If subsequent authority to proceed (ATP) and funding are received, Mission 2 will be taken through preliminary design review, with payload and mission support development commencing XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX.

o (U) USAKA will accomplish the final installation and test of the GPS tracking system. Work will continue on the first set of targets for ERIS and HEDI, and subsequent target sets will be started. Assembly of the prototype STARS should reach 75% and construction of the launch facility will reach 100% completion. Certification of the STARS motors will be completed. Target for the Aerothermal System (ATS) will be developed.

(U) FY 1990/1991 PLANNED PROGRAM:

o (U) HALO and ARGUS will continue to receive upgrades to improve sensor systems sensitivity and resolution.

o (X) If ATP and funding are received, JANUS 1b will be taken through critical design review, mission planning completed, a trajectory tape generated and initial fabrication of experimental payloads commenced to meet an estimated launch date XXXXXXXXXXX after ATP.

o (X) JANUS mission 1b fabrication of experimental payloads for launch will be completed. Mission 2 payload fabrication and mission development will progress to an XXXXXXXXX launch XXXXXXXXXXXXXXXXX on a Trident C-4 missile XXX XXXXXXXXXXXX. If ATP is received, a feasibility study will be conducted for mission 3.

o (U) USAKA will be ready to support ERIS and HEDI tests during this time frame.

o (X) XXXXX joint mission (with a foreign country) is planned to XXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX.

o (X) Fabrication of the first ERIS targets will be completed. The HEDI targets will be fabricated. Procurement of the boosters for the Aerothermal System will be started. XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX.

o (U) Improvements to the Central Data System (CDS), such as increasing the memory capacity of the center, tying the center into the National Test Bed (NTB), and adding more user terminal consoles to the center are planned.

(U) PROGRAM TO COMPLETION: This is a continuing program.

D. (U) WORK PERFORMED BY:

- o (U) Sandia National Laboratories - Albuquerque, NM; Livermore, CA
- o (U) Johns Hopkins University Applied Physics Lab - Baltimore, MD
- o (U) Lockheed Missile and Space Company - Sunnyvale, CA
- o (U) Hughes Aircraft Company - Canoga Park, CA
- o (U) 4950th Test Wing - Wright Patterson AFB, OH
- o (U) Dynamics Technology Inc. - Torrance, CA
- o (U) Aeromet, Inc. - Tulsa, OK
- o (U) Jet Propulsion Labs - Pasadena, CA

E. (U) COMPARISON WITH FY 89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES: (U)

CHANGE	SYSTEM CAPABILITIES	BUDGET YEAR SCHEDULE	BUDGET YEAR COST
(U) Tech (U) Sched (U) Cost	N/A	Delayed	Increased

NARRATIVE DESCRIPTION OF CHANGES

1. (U) TECHNICAL CHANGES: The mission concept design for JANUS mission 1b was changed to satisfy new phenomenology requirements.
2. (U) SCHEDULE CHANGES: JANUS 1 prime mission estimated launch time revised to correspond to later SSBN Demonstration and Shakedown Operation (DASO). JANUS 1B mission estimated launch time delayed due to lack of funding in FY 88 and FY 89.
3. (U) COST CHANGES: The planned launch time delay for mission 1 prime increased costs in FY 89 by an estimated $1,000K. Funding decrease ($2,300K) caused a 6 month delay in the first STARS.

F. (U) PROGRAM DOCUMENTATION: Various documents for each experiment or range upgrade and support.

G. (U) RELATED ACTIVITIES: None.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

Program Element: 0603220C
PE Title: Kinetic Energy Weapons (U)

Project Number: 34
Budget Activity: 02 Advanced Technology Development (U)

J. (U) MILESTONE SCHEDULE:

Milestone	Date
o (C) XXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (C) XXXXXXXXXXXXXXXXX	XXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXX	
o (U) GPS procurement for Kwajalein Missile Range	starts 1QFY89
o (X) XXXXXXXXXXXXXXXXXXXXXXX	XXXXXXX
o (X) XXXXXXXXXXXXXXXXX	XXXXXXXXXXXXXXXXXXXXX
o (X) XXXXXXXXXXXXXXXXXXXXXX	XXXXXXX

FY 1990/1991 RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons

Project Number: 35
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($in thousands)
Project Title: Technology Support (U)

Popular Name:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
Technology Support (U)	5,653	9,405	9,586	9,545	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(U) The purpose of this program is to provide kinetic energy weapon technology support. This includes trade studies to determine the best possible technologies in which to invest with the highest payoff to SDS element interceptors. Special studies to depict the performance of alternative and competing interceptor designs are flowed into technology research efforts.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments:

o (U) Trade studies conducted in conjunction with Defense Acquisition Board requirements demonstrated use of advanced technologies to significantly reduce the cost of the Space Based Interceptor system concept.
o (U) Support was provided to smoothly transition the management of the SBI, Exoatmospheric Reentry Interceptor System (ERIS) and the High Endoatmospheric Interceptor (HEDI) to the new management structures.

(U) FY1989 Planned Program:

o (U) Analysis studies are planned to catalog component technology maturation schedules, list unsatisfied phenomenology requirements, and blend this categories into realistic flight experiments for manifesting purposes.
o (U) Technology comparisons are planned for the Brillant Peebles concept, LEAP program and the SBI program.
o (U) Data reduction and archiving support is planned for JANUS and the airborne optical aircraft.

(U) FY1990/1991 Planned Program:

o (U) Support will continue to develop well planned affordable experiments to validate interceptor technology.
o (U) Programmatic support will be accomplished to being interceptor baselines under configuration control using technology maturity projections.

Program Element: 0603222C
PE Title: Kinetic Energy Weapons

Project Number: 35
Budget Activity: 02 Advanced Technology Development (U)

D. (U) WORK PERFORMED BY:

- o (U) ANSER Corp, Arlington, VA
- o (U) SAIC, McClean, VA
- o (U) Coleman Research Corp, Huntsville, AL
- o (U) AERES Corp, Arlington, VA

E. (U) COMPARISON WITH FY 1989 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	BUDGET YEAR COST
(U) Tech	NONE		
(U) Schd	NONE		
(U) Cost	NONE		

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) ENGINEERING CHANGES: N/A
2. (U) SCHEDULE CHANGES: N/A
3. (U) COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: N/A

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) MILESTONE SCHEDULE: N/A

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603112C
PE Title: Kinetic Energy Weapons (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)
Project Title: Theater Defense (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
Theater Defense	67,958	75,787	139,290	149,957	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The purpose of this project is to perform research on Theater Missile Defense technologies, interceptors, interceptor components and subcomponents in concert with both Theater Missile Defense architectures and the Strategic Defense Initiative Organization's global architecture within statutory provisions governing foreign participation in SDI research.

The project also conducts a foreign technology research program that supports and complements the Kinetic Energy Weapons technology programs. State of the art advances are being pursued and achieved in such technologies as rocket motors, guidance and control systems, millimeter wave radar/optical devices, non-nuclear warheads, thrusters, advanced structures, and launcher mechanisms.

The project is structured with a near-term goal to support current theater threats and to support technology alternatives in concert with theater and SDI architectures. The objectives of this project are being accomplished under efforts with the United Kingdom for electromagnetic gun and fluid diverter valve technology and the Netherlands for electromagnetic gun technology.

Additionally, objectives are being accomplished under several dynamic programs. Invite, Show and Test (IST) encourages US and allied contractors to identify existing hardware or modifications to existing hardware for use in an interim theater missile defense system. Selected components, subcomponents or systems will be tested in appropriate test beds, ground test facilities or by flight tests. Extended Range Interceptor (ERINT) will build upon existing technologies with increased radar seeker performance, a reduced weight warhead with a fusing function, larger attitude control motors, a more powerful rocket motor, and an engagement scenario to realistically validate the non-nuclear kill of a tactical missile. The Arrow missile experiment concept is a cooperative US-Israeli effort funded substantially by SDIO to validate the intercept and non-nuclear kill of a tactical missile.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

c (U) Work which started in FY 1986 on the Israeli combined propulsion effort and continued through FY 1987 & 88 demonstrated improved gun efficiencies.

c (U) Work began on a hybrid gun design to explore alternative combined propulsion options.

Program Element: 0603220C
PE Title: Surveillance, Acquisition, Tracking, & Kill Assessment (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

G. (U) RELATED ACTIVITIES: IST contributes technology advances to all SDI elements and to military and civil applications. Many of technical advances will have wide impact on military and civil technology.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603120 Project Number: 83
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment Budget Activity: 02

A. (U) RESOURCES ($ in Thousands)
Project Title: Support Programs

Popular Name:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Support Programs	43,510	31,861	32,962	35,016	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides funding for Army, Navy, and Air Force program management. For each service, this includes expenses for civilian personnel, travel (TDY), training, rents, communications, information management, utilities, printing and reproduction, supplies, equipment, and contracts for research and support services.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS: The funding provided by this project enables the executing agents to centralize recurring operating costs so that funding for technical research may be devoted solely toward that purpose.

D. (U) WORK PERFORMED BY: Primarily the civilian employees of the Army Strategic Defense Command (Huntsville AL and Crystal City VA), the Air Force Space Division (Los Angeles), and Navy RDT&E OP981 (The Pentagon) and OCNR (Crystal City). Civilian personnel costs comprise 60% of the support programs funding provided to the services. Work is also performed by the following major contractors:

Integration Support, Ford Aerospace Division, Los Angeles (AF)
Systems Engineering Support, ANSER Inc., Los Angeles (AF)
C&M for Simulation Center, COLSA Inc., Huntsville (Army)
Systems Engineering Support, GRC Inc., Huntsville (Army)
MIS Software Maint & Opns, Hewlett Packard, Hunstville (Army)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY: Support programs have not been separately identified in previous submissions.

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: N/A
2. SCHEDULE CHANGES: N/A
3. COST CHANGES: N/A

Program Element: 0603220 Project Number: 83
PE Title: Surveillance, Acquisition, Tracking and Kill Assessment Budget Activity: 02

F. (U) PROGRAM DOCUMENTATION: Services submit detailed justification using SDIO Work Package Directive format to document each year's support program requirements.

G. (U) RELATED ACTIVITIES: Support programs funding for the Army and Air Force is also found in each of the other four SDIO program elements under Project 83. (All Navy support program funding appears in this program element.)

H. (U) OTHER APPROPRIATION FUNDS: None

1. PROCUREMENT (Specify Appropriation): None

2. MILITARY CONSTRUCTION: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)

Budget Activity: 02 Advanced Technology Development

A. (U) RESOURCES: ($ in thousands)

Project Number & Title	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Tot Prog
20 Free Electron Laser Tech (U)	172,055	202,322	275,082	302,010	Continuing	
21 ATP-FC Technology (U)	252,348	183,691	254,617	244,610	Continuing	
22 Chemical Laser Tech (U)	100,060	100,139	346,486	511,190	Continuing	
23 Neutral Part Beam Tech (U)	109,018	98,598	114,829	144,766	Continuing	
24 MIRACL (U)	27,500	4,000	-0-	-0-	Completed	
25 CDTI/Emerging Tech (U)	167,142	96,153	64,729	62,462	Continuing	
81 IS&T/SBIR (U)	19,315	15,000	34,130	40,565	Continuing	
82 Delta Star (U)	65,218	72,962	-0-	-0-	Completed	
83 Support Programs	21,610	46,894	27,059	17,274	Continuing	
TOTAL FOR PROGRAM ELEMENT	934,266	819,759	1116,932	1322,877	Continuing	

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is one of six established to implement the President's Strategic Defense Initiative and is aimed at determining the most promising directed energy weapons (DEW) concepts for use in defense against ballistic missiles. Prior efforts have identified the following four concepts which will be investigated during the budget years:

1. (U) The spaced-based laser concept consists of self-contained, modular, laser battle stations deployed in orbit to engage ballistic missiles launched from anywhere on earth in the critical boost phase, and provide interactive discrimination in mid-course by destroying decoys and tagging heavier objects for acquisition by other defensive systems.

2. (U) The ground-based laser concept involves ground deployment of lasers with beam transmission to targets via orbiting space relay and focusing mirrors. Ground stations located in the United States would be capable of engaging targets world-wide.

3. (U) The space-based neutral particle beam (SBNPB) concept consists of battle stations in space which accelerate negative ions to near light speed to produce a high energy beam for engaging boost and post-boost vehicles as they rise above the earth's atmosphere, as well as reentry vehicle in mid-course. The SBNPB has several potential kill mechanisms ranging from structural melt at the high end to electronics disruption at the very low end. The SBNPB would also pose a significant threat to all hostile space-based asets.

4. (U) Nuclear-driven directed energy weapons (NDEW) concepts such as x-ray lasers, hypervelocity projectiles and multiple-pulsed lasers offer large and fundamental improvements in defensive technology including large lethal volume and alternative kill mechanisms. Although the SDI emphasizes non-nuclear technology, NDEW is investigated because of the broad application to the defensive mission and the implications for Soviet defensive and counter-defensive capabilities.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 20
Budget Activity: Advanced Technology Development (02)

A. (U) RESOURCES: ($ in Thousands)

Project Title Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Free Electron Laser Technology (U)	172,055	202,322	275,082	302,010	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
Free electron laser (FEL) technology is primarily focused on ground-based laser concepts but also includes technologies unique to space-basing. The goal of the ground-based efforts is to demonstrate the capability of high power ground-based lasers to perform boost-phase intercept of ICBMs and SLBMs and midcourse interactive discrimination. The major areas of parallel research in this part of the FEL program include: two competing technology candidates (the induction and radio frequency linear accelerators), one of which will be selected for the Ground-Based FEL Technology Integration Experiment (GBFEL TIE); beam control; optics; system engineering and integration of the TIE; and a supporting technology base for GBL, including the requisite space relay and mission mirror assets. The other part of the FEL technology area deals with the development of a space-based FEL (SBFEL) that will be able to address the strategic defense missions of boost-phase intercept and midcourse interactive discrimination. It should also provide an alternate technology path to the high brightness requirements of the long term mission.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

- (U) Designs for GBFEL TIE [illegible]ical facilities were completed and site preparation of common facilities at WSMR was begun
- (U) Key Livermore Paladin proof-of-concept experiments and Boeing visible oscillator RF experiments were completed
- (U) Site preparation was initiated on the dedicated superconducting accelerator facility by TRW in support of the SBFEL
- (U) A grazing interferometer for monocle figure control for relay mirrors was demonstrated

2. (U) FY 1989 Plan:

- (U) Complete Boeing burst mode RF experiments
- (U) Begin subsystem fabrication for all of the major components of the GBFEL TIE
- (U) Define GBL systems interfaces for BM/C^3
- (U) Initiate GBL prototype facilities and security design
- (U) Continue SBFEL basic physics research
- (U) Expand SBFEL concept formulation

Program Element: 0603221C | Project Number: 20
PE Title: Directed Energy Weapons (U) | Budget Activity: Advanced Technology Development (02)

- c (U) Select either the induction or radio frequency FEL for GBFEL TIE
- c (U) Complete the monocle single segment control demonstration and initiate design of multi-segment experiment
- o (U) Complete laboratory experiments for bifocal critical components

3. (U) FY 1990 Plan:

- o (U) Complete FEL laboratory experiments and critical technology validations
- c (U) Initiate detailed design of the beam control system and laser for an integrated test of a scalable system in FY 95
- c (U) Complete horizontal path propagation tests
- c (U) Continue parallel efforts for optics, optical coatings, and beam compensation technologies
- c (U) Complete design of all technical facilities and start construction
- c (U) Complete construction of superconducting GBFEL test facility at White Sands Missile Range (utilizing $32 Million in RDT&E funds)

4. (U) FY 1991 Plan:

- c (U) Initiate fabrication of the beam control system, laser, and other components for the FY 95 integrated test (long-lead items)
- o (U) Continue parallel technology efforts
- c (U) Conduct preliminary design review for beam control system
- c (U) Conduct preliminary design review for laser subsystem
- o (U) Conduct preliminary design review for control system
- o (U) Continue technical facility construction (utilizing $40 Million in RDT&E funds)

5. (U) Program Plan to Completion:

- o (U) Continue parallel technology efforts
- o (U) Conduct integrated test of the beam control system, laser, and other components for the FY 95 integrated test
- o (U) Begin procurement for full scale beam control system and scalable laser device integrated experiment in FY 96
- o (U) Begin procurement for space targets
- o (U) Initiate design and fabrication for superconducting FEL as a candidate for a SBFEL system
- o (U) Complete the High Power Relay Experiment in support of the GBL program
- o (U) Complete technical facility construction

D. (U) WORK PERFORMED BY: (Major Contractors)

- o (U) Induction Linac FEL - TRW, Redondo Beach, CA with technical support from LLNL, Livermore, CA
- c (U) RF Linac FEL - Boeing, Seattle, WA with technical support from LANL, Los Alamos, NM
- c (U) Beam Control (GBFEL TIE) - LMSC, Sunnyvale, CA

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 20
Budget Activity: Advanced Technology Development (02)

- o (U) System Engineering (GBFEL TIE) - TRW, Redondo Beach, CA
- o (U) Space-Based Technology - TRW, Redondo Beach, CA with technical support from LANL, Los Alamos, NM
- o (U) Afocal/Bifocal Technology - LMSC, Sunnyvale, CA

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech Schd Cost	Capabilities and goals for these technologies remain the same	FEL candidate selection delayed 1 yr; GBFEL TIE completion delayed 2 yrs.	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: Space mirror development program added to this effort from Project 21.
2. (U) SCHEDULE CHANGES: Induction or radio frequency FEL selection for GBFEL TIE delayed from FY 88 to FY 89; GBFEL TIE completion date delayed from FY 92 to FY 94 due to budget reductions.
3. (U) COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: None

G. (U) RELATED ACTIVITIES: Activities in this program element are closely coordinated with activities in the other SDIO program elements.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Funding this technology at the above levels will result in a Milestone I decision in the early 1990s.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 21
Budget Activity: Advanced Technology Development (02)

A. (U) RESOURCES: ($ in Thousands)

Project Title Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Acquisition, Tracking, Pointing and Fire Control Technology (U)	252,348	183,691	254,617	244,510	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
Acquisition, tracking, pointing and fire control (ATP/FC) technology efforts will advance requisite technologies to perform critical functions for candidate DEW concepts, both space- and ground-based. These functions include acquiring, identifying, and prioritizing the targets to be engaged, selecting and establishing the line-of-sight to the aimpoint, holding the beam on the aimpoint, assessing the resulting damage, and reinitiating the sequence to engage a new target. Efforts in the ATP/FC project are in several related areas. ATP/FC space experiments are under development to address both generic and concept-specific issues that can be adequately resolved only in space. These experiments include the Low Power Atmospheric Compensation Experiment (LACE), the Relay Mirror Experiment (RME), STARLAB, and the ATP portion of the Zenith Star experiment. Efforts within the ATP/FC technology base address major tracking/pointing component performance issues, and the development of technologies for advanced concepts.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

- o (U) Design of proof-of-principle large-angle SBL retargeting experiment, using the Rapid Retargeting - Precision Pointing (R2P2) simulator, was initiated and R2P2 performance further characterized
- o (U) Pointing and control efforts included initiation of the development of an integrated pointing and control experiment
- o (U) Attack management algorithm concepts for booster location and handover were evaluated
- o (U) STARLAB CDR was completed, and fabrication and testing of STARLAB experiment components was begun
- o (U) Assessments were completed on potential use of Zenith Star as long term space test bed for ATP

2. (U) FY 1989 Plan:

- o (U) Ground testing of RME and LACE spacecraft will be completed, with launch expected in FY 1990 assuming availability of appropriate launch vehicles
- o (U) Use the Rapid Retargeting Simulator (R2P2) to investigate technologies required for rapid retargeting of other DEW concepts.

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 21
Budget Activity: Advanced Technology Development (02)

- c (U) Support preliminary design phase of the Zenith Star experiment
- c (U) Laboratory demonstrations of attenuation of severe mechanical disturbances will include a combined optics/structures experiment and a prototype six degree of freedom isolation system
- c (U) Complete the baseline design of an Advanced Ground Tracking experiment
- c (U) Integrate the STARLAB experiments into a system for test and evaluation at the prime contractor's location
- c (U) Initiate the Attack Management Testbed (AMTB) implementation and software design

3. (U) FY 1990 Plan:

- c (U) Ship the STARLAB experiments to KSC for integration into the SPACELAB laboratory module and pallet configuration
- c (U) Support Zenith Star PDR and proceed with experiment development
- c (U) ATP equipment performance and experimental data will be returned from RME and LACE
- c (U) Conduct ground tests associated with large space structures

4. (U) FY 1991 Plan:

- o (U) Launch STARLAB and successfully complete the experiments
- c (U) Support Zenith Star critical design review (CDR)
- c (U) Review all data obtained from RME and begin planning activities for the FY 94 High Power Relay (HPR) experiments
- o (U) Begin attack management testbed operations, incorporating validated booster engagement, damage assessment, and multiple-target algorithms
- o (U) Demonstrate (on AMTB) the feasibility of autonomous execution of ATP/FC functions within ballistic missile defense time line constraints
- o (U) Complete initial phase of rapid retargeting simulator (R2P2) program
- c (U) Continue with advanced planning and design activities for the High Power Relay Experiment

5. (U) Program Plan to Completion:

- o (U) Support the assembly, test, launch, and execution of the Zenith Star ATP experiments
- o (U) Support the development phases for DEW, using ATP technology experiments and laboratory models as required
- o (U) Conduct active discrimination experiment in conjunction with SPIRIT III in FY 92-93
- c (U) Initiate planning activities associated with space testing of a large actively controlled, agile space structure experiment in the FY 96-97 time frame

Program Element: 0603221C | Project Number: 21
PE Title: Directed Energy Weapons (U) | Budget Activity: Advanced Technology Development (02)

D. (U) WORK PERFORMED BY: (Major Contractors)

- o (U) Kaman Aerospace, Colorado Springs, CO
- o (U) Martin Marietta, Denver, CO and Orlando, FL
- o (U) GRC, McLean, VA
- o (U) TASC, Santa Anna, CA and Reading, MA
- o (U) LMSC, Sunnyvale, CA
- o (U) Honeywell, Phoenix, AR
- o (U) TRW, Redondo Beach, CA
- o (U) Ball Aerospace, Boulder, CO

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech Schd Cost	Capabilities and goals for these technologies remain the same	STARLAB launch slipped 1 yr.	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: Technology base, particularly DEW fire control/attack management, severely limited for a second year.

2. (U) SCHEDULE CHANGES: Attack management test bed delayed an additional nine months; fire control algorithm development delayed one year; start of structures/pointing test bed delayed six months with minimum start-up funds; retargeting test bed unable to support Zenith Star this year to test retargeting performance; the integrated ATP test bed delayed six months and development of the digital track processor put off until FY 90; STARLAB launch slippe to FY 91 because of budgetary shortfalls and Shuttle slippages.

3. (U) COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: None

G. (U) RELATED ACTIVITIES: Activities in this program element are closely coordinated with activities in the other SDIO program elements.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Funding this technology at the above levels seriously impacts the ability to perform fire control feasibility demonstrations that can support a Milestone I decision in the early 1990s for SBL, GBL, and NPB.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 22
Budget Activity: Advanced Technology Development (02)

A. (U) RESOURCES: ($ in Thousands)

Project Title Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Chemical Laser Technology (U)	100,060	100,139	346,486	511,190	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
The chemical laser project is developing the technologies required for the space-based laser (SBL) concept. SBL subsystems include: the laser device; beam control; ATP/FC; and the space platform. The device is a chemical laser which extracts the high-power beam from molecules formed from the reaction of hydrogen and fluorine. The beam control subsystem corrects for aberrations introduced by the device and the high-power optical elements, establishes the boresight of the beam and focuses it on target, and moves the beam from target to target. The ATP/FC subsystem acquires the target, selects and maintains the aimpoint during irradiation, and assesses damage to the target. Key SBL technology developments include the ALPHA laser, the Large Advanced Mirror Program (LAMP) mirror, and the Large Optics Demonstration Experiment (LODE) beam control system architecture. The STARLAB Shuttle experiments will establish the technical feasibility of the required ATP functions. These technologies all scale readily to entry level performance requirements. The Zenith Star program will resolve SBL integration issues, and high-power beam control issues in space for all high-energy laser concepts. ALPHA, LAMP, and LODE technologies will be integrated in a series of ground experiments to investigate and validate the performance of the high-power beam control subsystem. Options for space experiments are maintained with designs for integrating the experimental hardware into a research spacecraft. Technologies are also being developed and validated for system performance growth to the very high brightness levels which may be required to counter robust responsive threats in the far term. These technologies include conventional device and aperture coupling (master oscillator - power amplifier and mechanical array phasing), use of a nonlinear optical phenomenon (stimulated Brillouin scattering) for simultaneous phasing and beam clean-up, and short-wavelength chemical lasers.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

- o (U) Achieved stable combustor ignition and hot flow with heat release for the ALPHA laser
- o (U) LAMP acceptance tests successful
- o (U) Two meter optical test flat coated to excellent uniformity using reactive sputtering technique
- o (U) Refractive wide field-of-view infrared outgoing wavefront sensor tests successful
- o (U) Detailed design for subscale wide field-of-view telescope complete; fabrication initiated

Program Element: 0603221C Project Number: 22
PE Title: Directed Energy Weapons (U) Budget Activity: Advanced Technology Development (02)

- c (U) Zenith Star baseline established
- o (U) Established feasibility of phase conjugation of high-power HF chemical lasers using stimulated Brillouin scattering (SBS) in a flowing cell
- o (U) Completed gain measurements for short-wavelength HF chemical laser and developed high damage threshold coatings for high-power applications
- o (U) Short-wavelength HF chemical laser testing achieved twice breakeven efficiency

2. (U) FY 1989 Plan:

- o (U) Complete ALPHA laser performance tests
- c (U) Complete LAMP mirror performance tests
- o (U) Fabricate and test subscale wide field-of-view telescope for optical retargeting experiments
- c (U) Complete Zenith Star System Requirements Review
- c (U) Fabricate wide field-of-view outgoing wavefront sensor for optical retargeting experiments
- c (U) Begin scale-up of HF short wavelength chemical laser technology

3. (U) FY 1990 Plan:

- c (U) Complete design of on-axis and off-axis segments for full-scale flight-capable primary mirror; initiate fabrication of faceplates
- c (U) Complete Zenith Star System Interim Design Review
- c (U) Complete Zenith Star Space Vehicle Subsystem Interim Design Reviews
- c (U) Complete Zenith Star Forward Space Vehicle System Final Design Review
- c (U) Complete beam expander and actuator/isolator risk reduction experiments
- c (U) Initiate long lead procurements for Zenith Star
- o (U) Complete evaluation of multi-color holographic optical element technologies
- c (U) Complete grating fabrication technology validation for large-aperture mirror segment
- o (U) Complete beam control system integration for wide-field-of-view rapid retargeting experiments
- o (U) Complete gain generator optimization for HF short-wavelength chemical laser
- o (U) Complete risk reduction experiments for high-power continuous wave scale-up of beam control using SBS
- o (U) Complete preliminary design for high-power beam control experiments validating entry level beam control architecture

4. (U) FY 1991 Plan:

- c (U) Complete Zenith Star Aft Space Vehicle Subsystem Interim and Detailed Design Reviews
- o (U) Complete Zenith Star Aft Space Vehicle System Final Design Review

Program Element: 0603221C Project Number: 22
PE Title: Directed Energy Weapons (U) Budget Activity: Advanced Technology Development (02)

- o (U) Complete Zenith Star Space Vehicle Interface and Systems Engineering Interim and Detailed Design Reviews
- o (U) Complete capture track subsystem, beam control and transfer subsystem risk reduction experiments
- o (U) Begin fabrication of forward spacecraft structure and beam expander
- o (U) Complete fabrication and test of faceplates for full-scale flight-capable primary mirror
- o (U) Complete subscale performance demonstration for short-wavelength HF chemical laser
- o (U) Complete preliminary design review for high-power continuous wave scale-up of coherent beam and aperture combining using stimulated Brillouin scattering (SBS)
- o (U) Complete critical design for high-power beam control experiments validating entry level beam control architecture
- o (U) Complete static and dynamic wide-field-of-view optical retargeting experiments
- o (U) Complete tests validating performance of holographic grating elements (HOEs) at high-power

5. (U) Program Plan to Completion:

- o (U) Establish feasibility of combining large apertures and laser devices into laser battle stations having very bright and agile beams for far term missions
- o (U) Complete high-power scale-up of short-wavelength chemical laser
- o (U) Fabricate and test full-size flight-capable primary mirror
- o (U) Perform Zenith Star high-power ground integration tests
- o (U) Perform Zenith Star high-power space tests if the space test option is exercised
- o (U) Complete high-power experiments validating hierarchical beam control using outgoing wavefront sensing
- o (U) Initiate design for SBL Element prototype

D. (U) WORK PERFORMED BY: (Major Contractors)

o (U) Laser Device	- TRW, Redondo Beach, CA
o (U) Beam Control	- LMSC, Sunnyvale, CA
	- PERKIN-ELMER, Danbury, CT
	- HUGHES AIRCRAFT, El Segundo, CA
o (U) Large Optics	- ITEK, Boston, MA
	- KODAK, Rochester, NY
o (U) Zenith Star	- Martin Marietta, Denver, CO
	- LMSC, Sunnyvale, CA
	- TRW, Redondo Beach, CA

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 22
Budget Activity: Advanced Technology Development (02)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech Schd Cost	Capabilities and goals for these technologies remain the same		

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: None

G. (U) RELATED ACTIVITIES: Activities in this program element are closely coordinated with activities in the other SDIO program elements.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Funding this technology at the above levels will result in a Milestone I decision in the early 1990s.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 23
Budget Activity: Advanced Technology Development (02)

A. (U) RESOURCES: ($ in Thousands)

Project Title Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Neutral Particle Beam Technology (U)	109,018	98,598	114,829	144,766	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
The neutral particle beam (NPB) project exploits the capability of a stream of atomic particles to penetrate into a target and provide lethal energies and/or induce signatures that permit discrimination. Such a beam is also capable of effecting electronics kill on launch systems in the boost and post-boost phases. The more robust evolving NPB systems will increase target handling rates and will have the ability to attack and kill reentry vehicles in the midcourse phase of the attack. The NPB project has a technology development segment, a ground-based technology integration segment, and a space experiments segment. Together, these segments address the key technical and system issues associated with the feasibility of deploying an NPB system capable of boost and post-boost intercept as well as midcourse discrimination. The technology development segment concentrates on developing enabling technologies for the ground and space experiments and initial deployable NPB systems. In the ground-based integration experiments, the Accelerator Test Stand (ATS) is used to integrate and test low energy components; the Ground Test Accelerator (GTA) is the primary test bed for initial NPB system development and also for advanced technologies such as high brightness ion sources, advanced neutralizer development, and ATP/PC; and the Continuous Wave Deuterium Demonstrator (CWDD) examines high duty factor and deuterium operation at low energies. The NPB space experiments include Beam Experiments Aboard Rocket (BEAR) which addresses basic space operability issues, and Pegasus, an orbital experiment which will address key NPB issues that cannot be tested on the ground.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

- o (U) BEAR accelerator components completed and integrated
- o (U) GTA facility construction initiated at Los Alamos
- o (U) CWDD contract was awarded; NPB weapon point design was initiated
- o (U) The first ramped gradient drift tube linear accelerator (DTL) was tested on the ATS at Los Alamos
- o (U) High average power issues were also addressed on the ATS with first testing of a cryogenic DTL driven by a radio frequency quadrupole (RFQ)
- o (U) Experimental requirements were established to redefine Pegasus space experiment
- o (U) Large foil neutralizer fabricated
- o (U) 30 cm telescope with closed-loop computer control demonstrated
- o (U) GTA ion source brightness requirement achieved

Program Element: 0603221C Project Number: 23
PE Title: Directed Energy Weapons (U) Budget Activity: Advanced Technology Development (02)

2. (U) FY 1989 Plan:

- o (U) Fabricate and test weapon diameter foil neutralizer
- o (U) Complete GTA facility construction; conduct GTA design review
- o (U) Complete CWDD Phase I efforts, yielding NPB weapon point design; initiate CWDD fabrication
- o (U) Demonstrate high current beam funneling on ATS
- o (U) Initiate design of power system demonstrator (PSD)
- o (U) Complete fabrication and test of first cryogenic RFQ for deuterium operation
- o (U) Demonstrate weapons diameter NPB telescope
- o (U) Conduct Laser Resonance Fluorescence beam sensing experiments at the Neutral Beam Test Facility
- o (U) Conduct the BEAR sub-orbital flight experiment at WSMR
- o (U) Test superconducting accelerator cavity

3. (U) FY 1990 Plan:

- o (U) Demonstrate two beam funneling
- o (U) Demonstrate a hydrogen ion source at CW duty factor and weapon level brightness
- o (U) Continue fabrication of GTA components and CWDD subsystems
- o (U) Initiate PSD fabrication
- o (U) Conceptual Design Review of Pegasus space experiment
- o (U) Integrated ATP/beam line test

4. (U) FY 1991 Plan:

- o (U) Complete fabrication of components for the CWDD demonstration and initiate integration
- o (U) Continue fabrication of high energy GTA components
- o (U) Demonstrate GTA operation at the 24 MeV level and integrate results in Pegasus detailed design
- o (U) Install superconducting accelerator section on CWDD beam line

5. (U) Program Plan to Completion:

- o (U) Complete CWDD integration and test in FY 92
- o (U) Preliminary beam control demonstration at 24 MeV will occur in FY 92, precision beam control demonstration in FY 94
- o (U) GTA operational at high energy
- o (U) Continue advanced component development of photoneutralizers, advanced ion sources, and innovative accelerating structures
- o (U) Complete fabrication of PSD and integrate operation with CWDD
- o (U) GTA beam used to flood illuminate realistic targets
- o (U) Complete design, fabrication, and orbital testing of Pegasus space experiment

Program Element: 0603221C | Project Number: 23
PE Title: Directed Energy Weapons (U) | Budget Activity: Advanced Technology Development (02)

D. (U) WORK PERFORMED BY: (Major Contractors)

o (U)	Test Bed Facilities	- LANL, Los Alamos, NM - Grumman Aerospace, Bethpage, NY
o (U)	Ion Sources	- LBL, Berkeley, CA - Culham Laboratories, Abingdon, UK
o (U)	Accelerator Components	- Grumman Aerospace, Bethpage, NY - McDonnell Douglas, St. Louis, MO - LANL, Los Alamos, NM
o (U)	Beam Sensing/Optics	- ANL, Chicago, IL - BNL, Upton, NY - LANL, Los Alamos, NM
o (U)	Neutralizers	- HEDL, Richland, WA
o (U)	Space Experiments	- LANL, Los Alamos, NM

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech Schd Cost	Capabilities and goals for these technologies remain the same	Fact of life slippage of 1 yr - GTA; 3 yrs - Space Experiment	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: Army Background Experiment (ABE) flight delayed 3 quarters; FY 88 program precluded initiation of ATP effort; Lawrence Berkeley National Laboratory CW ion source program reduced and delayed 6 months.

2. (U) SCHEDULE CHANGES: ISE cancellation forced redefinition of space experiment (delays space experiment 3 years); GTA program funding reductions caused slippage of GTA-24 demonstration by 1 year - GTA high energy technology not pursued.

3. (U) COST CHANGES: Total program cost growth of 20-25 percent due to budget reductions and funding fluctuations manifested as leveraged delays in subsystem component technology development and increased program risk.

F. (U) PROGRAM DOCUMENTATION: None

G. (U) RELATED ACTIVITIES: Activities in this program element are closely coordinated with activities in the other SDIO program elements.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Funding this technology at the above levels will result in a Milestone I decision in the early 1990s.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 2S
Budget Activity: Advanced Technology Development (02)

A. (U) RESOURCES: ($ in Thousands)

Project Title Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
CDTI/Emerging Technologies (U)	167,142	96,153	64,729	62,462	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
This project includes excimer lasers, charged particle beams, nuclear directed energy weapons, and concept development for technology identification (CDTI). In the excimer laser technology area, efforts will establish and demonstrate the feasibility of repetitively pulsed excimer lasers. High pulse repetition frequency device candidates are being pursued under the excimer, moderate power, Raman-shifted laser device (EMRLD) program. The charged particle beam (CPB) program is investigating a concept called DELPHI which would interactively discriminate decoys from reentry vehicles for a ground-based kinetic kill system and which is investigating a potential robust kill mechanism to augment a ground-based defensive system. The DELPHI technology development program is focusing on three primary efforts required to demonstrate feasibility of a charged particle beam weapon: beam propagation, laser research, and lightweight electron accelerator development. In the area of nuclear directed energy weapon (NDEW) technology, the DoD will perform concept definition studies, develop support technology, and perform integrated experiments that allow assessments of the military utility of NDEW system concepts. Efforts in the area of CDTI involve the four DEW basic concepts, currently at varying levels of maturity. The ongoing initial concept formulation effort is designed to identify the performance requirements of the weapon system to guide technology development and provide conceptual designs for evaluation by the overall architect. As the overall strategic defense architecture efforts mature in their definition of performance requirements, DEW entry level and evolutionary systems concepts will be updated.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

- o (U) EMRLD Beam Quality Demonstrator Master Oscillator was completed; design and fabrication of 50 kW power amplifier commenced
- o (U) DELPHI experiments to determine inductive, magnetic, and emittance erosion rates were completed; a laser-switched linear induction accelerator module was built and demonstrated; experiments measuring efficiency of Scantron RF accelerator were completed; laser beam pointing hardware was fabricated and bench-tested
- o (U) Experiments continued to support understanding of NDEW physics, with emphasis on diagnostics and output characteristics

Program Element: 0603221C | Project Number: 25
PE Title: Directed Energy Weapons (U) | Budget Activity: Advanced Technology Development (02)

o (U) Increasing CDTI emphasis was placed on interfaces of DEW systems with other elements of the defense architecture; conceptual designs were reevaluated to permit incorporation of new ideas and developing technology that will enhance survivability of system

2. (U) FY 1989 Plan:

- o (U) Complete the EMERLD master oscillator and install Raman cell at 5 kW power level; program transferred to USAF control
- o (U) Incorporate DELPHI laser beam steering capability into laser generated channel; start construction of accelerator capable of producing several MeV at a few kiloamps; initiate detailed designs of a compact laser; begin designs for rocket-borne hardware
- o (U) Perform demonstrations of critical NDEW components for ATP; prepare designs for tracking and pointing experiment
- o (U) Analyze possible CDTI synergisms arising from use of onboard DEW sensors to augment dedicated SDS sensor systems; emphasize the defining of concept of operations for various DEW systems within context of joint DEW-KEW deployments; examine DEW system concepts at subsystem and even component level to begin addressing issues of maintainability and manufacturability
- o (U) Complete top level study of DEW utility for NATO theater defense

3. (U) FY 1990 Plan:

- o (U) Extend propagation range of the DELPHI beam
- o (U) Complete development of a laser ionization scheme based upon the Raman-shifted excimer laser technique
- o (U) Begin construction of a prototype induction linac
- o (U) Begin fabrication of hardware for a space experiment

4. (U) FY 1991 Plan:

- o (U) CDTI concepts selected as candidates for development and deployment will undergo concept formulation to identify overall construct of an operational system and to provide initial designs of system level demonstrations that will validate technology and provide engineering prototypes

5. (U) Program Plan to Completion:

- o (U) DoE will continue NDEW research; a nonnuclear concept demonstration by DoD, as well as determination of overall weapon concept feasibility, will continue to be studied

D. (U) WORK PERFORMED BY: (Major Contractors)

- o (U) Excimer laser - AVCO Everett Research Lab, Everett, MA
- o (U) DELPHI - SNL, Albuquerque, NM

Program Element: 0603221C
PE Title: Directed Energy Weapons (U)
Project Number: 25
Budget Activity: Advanced Technology Development (02)

- (U) NDEW
  - LANL, Los Alamos, NM
  - LLNL, Livermore, CA
  - INEL, Idaho Falls, ID
  - NRL, Washington, D.C.
  - DNA, Alexandria, VA
- (U) CDTI (SBL)
  - Rockwell, Seal Beach, CA
  - LMSC, Sunnyvale, CA
- (GBL)
  - TRW, El Segundo, CA
  - LMSC, Sunnyvale, CA
- (NPB)
  - Boeing, Seattle, WA
  - Grumman, Bethpage, NY
- (NDEW)
  - Martin Marietta, Denver, CO
- (NATO)
  - Logica Defense Systems, UK

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech Schd Cost	Capabilities and goals for these technologies remain the same		

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: DELPHI program maintained as technology program only - funding not available to conduct experimental program; EMRLD downscoped from 50 kW to 5 kW, and transferred to USAF; study of DEW utility in NATO theater defense initiated in FY 88, with planned completion in FY 89.
2. (U) SCHEDULE CHANGES:
3. (U) COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: None

G. (U) RELATED ACTIVITIES: Activities in this program element are closely coordinated with activities in the other SDIO program elements.

H. (U) OTHER APPROPRIATION FUNDS: Air Force #0603605F provides EMRLD support.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

o (U) Millimeter wave radar antenna contract was awarded to Contraves Aerospace of Italy in late FY 1987. Hardware subcomponents were developed, tested and integrated in FY88 with progress toward a system demonstration in FY 1989.

o (U) Contract awarded to support testing of IST candidates and all theater defense efforts.

o (U) Eight IST contracts awarded (5 US, 3 Foreign) to contractors to test candidate TMD components, subsystems, and systems. Initial testing began.

o (U) Arrow missile experiment contract initiated with Israel. Subsystem preliminary design reviews were satisfactorily completed in accordance with the program schedule.

o (U) ERINT underwent a major restructuring effort intended to provide traceability and focus on establishing a demonstration and validation effort for ERINT as a candidate near term tactical missile defense system. The attitude control motor technology successfully completed its demonstration validation tests (DVTs), and the design of the more powerful traveling wave tube (TWT) millimeter wave (MMW) radar was completed. Hardware development for the radar seeker is under way.

2. (U) FY 1989 Planned Program

o (U) Israeli combined propulsion work on the hybrid gun continues in FY 1989. Work initiated to design a combined propulsion demonstration using the most efficient electrothermal design available.

o (U) Delivery of the Millimeter Radar Prototype by Contraves Aerospace of Italy. Follow on system analysis and testing of prototype for future applications will begin.

o (U) Contractors (US and allied) with hardware for testing against near-term theater defense threat have been identified for participation in Invite, Show, and Test. Testing of this hardware will continue.

o (U) ERINT will continue the development of the radar, the inertial measurement unit, the seeker, the guidance processor unit, the lethality enhancer and the solid rocket motor. The airframe design will be completed. Simulation and analysis efforts will include subsystem simulation, guidance simulation, and hardware-in-the-loop testing.

o (U) Arrow missile experiment (Israeli) will be continued with the objective of flight tests in FY 1991.

Program Element: 0603211C
PE Title: Kinetic Energy Weapons (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

3. (U) FY 1990/1991 Planned Program

c (U) Continue Israeli efforts in combined propulsion with objective of small scale demonstration.

c (U) Continue efforts in Italy on millimeter wave radars in FY 1990 with testing and studies in those areas which show promise.

c (U) Possibly begin additional testing of components in IST recommended by theater architecture studies.

c (U) ERINT will complete the development of the seeker, the inertial measurement unit, the guidance processor unit, the lethality enhancer and the solid rocket motor. Modifications required for the attitude control motors will be completed after the system design trade studies are conducted.

c (U) Arrow missile experiment (Israeli) will be continued with the objective of flight tests in FY 1991.

4. (U) Program to Completion This is a continuing program.

D. (U) WORK PERFORMED BY:

- c The government of the Netherlands.
- c Plessey Electronics, Southhampton, UK.
- c Contraves Aerospace, Italy.
- c Boeing Aerospace, Seattle, WA.
- c Royal Armaments Research & Development Establishment, UK.
- c Soreq Nuclear Research Center, Israel.
- c The government of Israel and Israeli Aircraft Industries.
- c LTV, Fort Worth, TX.
- c AEG, Federal Republic of Germany.
- c Rockwell, Anneheim, CA.
- c Various contractors and government laboratories participate in the Invite, Show, and Test program.

Program Element: 0603311C
PE Title: Kinetic Energy Weapons (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	Modified	Stretched	Caused realignment
Schd	Restructured	Stretched	Will Increase
Cost	Stretched	Stretched	Increased

NARRATIVE DESCRIPTION OF CHANGES

1. (U) TECHNICAL CHANGES: The ERINT program was restructured to include a missile seeker with a longer range capability and greater kinematic performance.

2. (U) SCHEDULE CHANGES: As the ERINT program underwent restructure, the schedule changed from a 36 to a 52 month program. The driving factor for the restructure was the decrement in FY 88 funding.

3. (U) COST CHANGES: Arrow contract cost increased to $153M due to delay in contract award, necessitated by MCA development and contract negotiations. Funding of $2.5M was added to the ERINT project to conduct a concept definition study the the Theater High Altitude Atmospheric Defense (THAAD) interceptor. This system would be used in a theater defense overlay role. The technology is a derivative from the HEDI program.

F. (U) PROGRAM DOCUMENTATION: Several SDIO Work Package Directives and their implementing guidance.

G. (U) RELATED ACTIVITIES: Theatre Defense also appears as Project 42 in Program Element 0603223C, Systems Analysis & Battle Management.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS:

- MCA with Netherlands concerning HVG technology signed July 1987.
- MCA with Israel MOD concerning ATBM, signed 29 June 1988.

J. (U) MILESTONE SCHEDULE:

- Soreq
  Gun Demo 2Q91

- Netherlands
  Hyper Velocity Launch Checkout Completed 3Q89

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

- Contraves
  Radar Antenna Demonstration Test Completed 1Q89

- IST

Testing Completed	3Q89
Data Evaluation	4Q89

- ERINT

Initial Design Review	2Q89
Final Design Review	4Q89
Flight Test #1	3Q91
Flight Test #2	4Q91
Flight Test #6	2Q92
Final Report	3Q92

- ARROW

CDR Completion	4Q89
Prop and Control	4Q89
First Flight Test	1Q91
Last Flight Test	2Q91
Final Report	3Q91

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)

Popular Name	FY88 Actual	FY89 Estimate	FY90 Estimate	FY91 Estimate	To Complete	Total Program
Innovative Science and Technology	23,365	21,702	41,277	49,190	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Explores innovative technologies for kinetic energy weapons. Seeks revolutionary breakthroughs in all technologies that would make a leap in capability for SDI kinetic energy weapons. The funding totals also include all SDI SBIR awards, which make about a third of FY 89 totals.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments: IST research advanced many innovations for consideration by SDI system designers. For example:

- (U) Electromagnetically accelerated objects to six kilo-meters per second.
- (U) Showed a fiber-optic gyroscope that could shrink control of an interceptor down to the back of a focal plane.
- (U) Adapted the principle of scanning tunneling microscopy to make an accelerometer far tinier than ever before.
- (U) Confirmed the composition of the armature plasma for electromagnetic railguns.
- (U) Built a test device to measure armature resistivity and another for measuring temperatures up to 20,000 K.

(U) FY1989 Planned Program: IST efforts will continue to explore the cutting edge of kinetic energy technologies.

(U) FY1990/1991 Planned Program: Continue exploratory initiatives. Specific projects cannot be predicted.

(U) SBIR Accomplishment and Plans: No SBIR Phase 2 has yet been completed. SDI has selected 30 Phase 2 winners in KEW technologies. About half have started the Phase 2 work. In FY88 it also selected 40 new Phase 1 winners. The first Phase 2 completions will happen in FY89. SBIR awards will be made in accordance with PL97-219 to the best proposals offered across all the technical topics solicited by SDI.

D. (U) WORK PERFORMED BY: Various institutions (universities, private firms, national laboratories, federally funded research centers) under contract to Army and other agencies.

Program Element: 0603222C
PE Title: Kinetic Energy Weapons (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

E. (U) COMPARISON WITH FY88 DESCRIPTIVE SUMMARY: Technical accomplishments are all first-ever events.

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION:

G. (U) RELATED ACTIVITIES: IST contributes technology advances to all SDI program elements and to military and civil applications. Many of technical advances will have wide impact on military and civil technology.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Not Applicable. Research is the forefront of technology where events cannot be predicted.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603222 | Project Number: 83
PE Title: Kinetic Energy Weapons | Budget Activity: 02

A. (U) RESOURCES ($ in Thousands)
Project Title: Support Programs

Popular Name:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Support Programs	31,702	28,967	22,476	22,974	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project funds for Army program management expenses for civilian personnel, travel (TDY), training, rents, communications, information management, utilities, printing and reproduction, supplies, equipment, and contracts for research and support services.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS: The funding provided by this project enables the Army Strategic Defense Command to centralize recurring operating costs so that funding for technical research may be devoted solely toward that purpose.

D. (U) WORK PERFORMED BY: Primarily the civilian employees of the Army Strategic Defense Command (Huntsville AL and Crystal City VA). Civilian personnel costs comprise 60% of the support programs funding provided. Work is also performed by the following major contractors:

C&M for Simulation Center, COLSA Inc., Huntsville
Systems Engineering Support, GRC Inc., Huntsville
MIS Software Maint & Opns, Hewlett Packard, Hunstville

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY: Support programs have not been separately identified in previous submissions.

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: N/A
2. SCHEDULE CHANGES: N/A
3. COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: The Army Strategic Defense Command submits a detailed justification using SDIO Work Package Directive format to document each year's support program requirements.

G. (U) RELATED ACTIVITIES: Support programs funding for the Army is also found in each of the other four SDIO program elements under Project 83.

Program Element: #0603222 Project Number: 83
PE Title: Kinetic Energy Weapons Budget Activity: 02

H. (U) OTHER APPROPRIATION FUNDS: None

1. PROCUREMENT (Specify Appropriation): None

2. MILITARY CONSTRUCTION: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Analysis/Battle Management (U)

Budget Activity: 02 Advanced Technology Development

A. (U) RESOURCES: ($ in thousands)

Project Number & Title	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
40 SDS Engineering & Spt (U)	72,590	82,098	131,407	201,071	Continuing	
42 Theater Defense (U)	50,500	30,605	48,922	46,720	Continuing	
43 BM/C3 Technology (U)	64,306	58,572	86,368	107,817	Continuing	
44 BM/C3 Experimental Sys (U)	91,073	74,179	143,778	203,071	Continuing	
45 National Test Bed (U)	77,713	100,179	115,827	121,832	Continuing	
46 SDI Phase I (U)	45,201	63,470	125,210	155,531	Continuing	
47 Test & Evaluation (U)	5,861	8,477	9,985	14,977	Continuing	
81 IS&T/SBIR (U)	12,885	15,350	25,832	30,832	Continuing	
83 Support Programs (U)	22,862	53,269	70,558	70,871	Continuing	
85 Technology Applications (U)	18,468	20,277	22,967	22,968	Continuing	
TOTAL FOR PROGRAM ELEMENT	461,459	506,476	780,854	975,627	Continuing	

B. (U) BRIEF DESCRIPTION OF THE ELEMENT: This program element is one of six established to implement the President's Strategic Defense Initiative. The program encompasses demonstration and validation of Phase I elements of the Strategic Defense System (SDS); devising and analyzing alternative SDS architectures; development of the technology and systems needed for survivable and effective battle management (BM) and command, control and communications (C3) capabilities; and various support and program integration activities. Efforts include the establishment of a SDI Institute to provide independent and objective support to the SDI program; development of a National Test Bed for comprehensive testing, evaluation, and comparison of alternative architectures and their BM/C3 components; and a Theater Defense project to support the President's commitment to protect our allies from the threat of theater ballistic missiles.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)
Project Number: 40
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)
Project Title: Strategic Defense Systems (SDS) Engineering and Support (U)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
SDS Engineering and Support	72,590	82,098	131,407	201,071	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
Applies engineering, analytical, and technical disciplines to the conceptual development and evolution of the full range of SDS architectures. Provides program management and technical support to the SDS Phase I program office and is responsible for SDS Follow-On Phases. Seven task areas are defined as: Systems Engineering, SDS Integrated Logistics Support, Cost Analysis, Producibility & Manufacturing, Civil Engineering/Environmental Analysis, SDS Follow-On Architectures, and Operations Interface.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Program

- o (U) Completed the System Architecture and Key Trade-Off Studies Effort which provided the basis for the SDS Phase I system concept. Initiated evolutionary follow-on architecture analysis; established initial approach to define follow-on operational requirements;
- o (U) Initiated an Interim Requirements Review (IRR); conducted initial late-mid course Near-term System Integration Test/Evaluation (NSITE) experiment; completed initial systems-level Logistics Support Analysis (LSA); installed logistics modeling capability on the National Test Bed (NTB); developed the SDS Phase I Single Best Estimates, independent cost assessments, and cost effectiveness assessments.
- o (U) Implemented Manufacturing Operation Development & Integration Laboratory (MODIL) with initial emphasis on kinetic energy interceptor optics; and supported the facilities, siting, and environmental functions required for demonstration/validation test activities.
- o (U) Supported the development of the United States Space Command Concept of Operations for the SDS Phase I; and performed operational analyses of Phase I effectiveness in meeting JCS requirements in unconstrained and arms control environments.

2. (U) FY 1989 Planned Program.

- o (U) Develop systems engineering documents and tools; conduct IRR of the SDS Phase I; develop a draft SDS Phase I System Specification; conduct Cost and Operational Effectiveness Analyses (COEAs) of SDS Phase I; develop system and architecture cost goals; develop system-level Integrated Logistics Support Plan (ILSP) and updated element ILSPs; complete the Comprehensive Operational Support Model for Space; identify initial operations & support (O&S) and reliability, availability, maintainability (RAM) drivers and goals for SDS Phase I elements; begin High Temperature Superconductivity (HTS) MODIL; complete Envi-

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)
Project Number: 40
Budget Activity: 02
Advanced Technology Development

ronmental Impact Statement (EIS) for Kwajalein Atoll and begin environmental documentation for all SDS program decisions.

- (U) Perform operational effectiveness analysis of Phase I, including operational integration and strategic gaming.
- (U) Perform analysis of the Phase I architecture to assure Phase I BM/C³ has preplanned growth capacity to accommodate Phase 2 elements.

3. (U) FY 1990/1991 Planned Program.

- (U) Task 1, Systems Engineering -- Conduct SDS Phase I Systems Requirements Review (SRR); and support development of an SDS system specification.
- (U) Task 2, Integrated Logistics Support -- Continue supportability evaluation of evolving Phase I and follow-on architectures and SDS elements; update supportability documentation (ILSPs, LSA); refine O&S and RAM objectives; plan satellite servicing technology demonstration program.
- (U) Task 3, Producibility and Manufacturing -- Continue Optics and HTS MODIL implementation; initiate other high pay-off MODILs (launch, sensors, software) needed to demonstrate required manufacturing technologies.
- (U) Task 4, Cost Analysis -- Continue cost research and estimating; conduct cost and operational effectiveness analyses (COEAs) of SDS Phase I at more detailed levels; develop system and architecture cost goals and cost reduction (could cost) procedures to ensure affordability for all phases of the SDI program.
- (U) Task 5, Civil Engineering/Environmental Analysis -- Continue to provide management oversight and guidance for the acquisition of facilities to support the SDI research program; initiate the facility acquisition process to support a full scale development decision.
- (U) Task 6, BM/C3 and Strategic Architecture -- Validate system functions for the Follow-On Phase SDS; establish system description to level 3 functional allocation; establish Follow-On Phase system description to level 4; validate level 3 and prepare Defense Acquisition Board presentation; develop simulation tools to support studies of follow-on architecture elements.
- (U) Task 7, Operations Interface -- Concentrate on analyses of Phase I and effectiveness of follow-on phases through the use of computer simulations, operational strategic gaming and operational integration definition with the operational commands.

D. (U) WORK PERFORMED BY:

- Oak Ridge National Laboratory, Oak Ridge TN;
- TASC, Arlington, VA;
- Advanced Technology Inc., Reston, VA & Camanillo, CA;
- Applied Research Inc. (ARI) Huntsville, AL & Arlington, VA;
- Dynamic Research Corporation, Arlington, VA;
- Tecolote, Los Angeles, CA;
- ETA Technologies, Los Angeles, CA;
- The Harris Group, Reston, VA;
- SAIC, McLean, VA, Buffalo, NY, San Diego, CA;

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- o SPARTA, Huntsville, AL & McLean, VA;
- o TRW, El Segundo, CA;
- o Rockwell International, Downey, CA;
- o Martin Marietta, Denver, CO;
- o Riverside Research Institute (RRI), Rosslyn, VA & NYC,NY;
- o ANSER, Arlington, VA;
- o Orion Research, Rosslyn, VA;
- o Booz-Allen-Hamilton, Rosslyn, VA;
- o SRS Technologies, Rosslyn, VA;
- o Technology Assessment & Transfer, Annapolis, MD;
- o BDM, McLean, VA;
- o General Electric (GE), Philadelphia, PA & Pittsfield, MA;
- o The Rand Corporation, Santa Monica, CA;
- o IDA, Arlington, VA.

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	Cancellation of AOS		
Schd		1-2 yr Delay in Other Contracts	
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. (U) TECHNICAL CHANGES: Cancelation of Airborne Optical Sensor (AOS) MODIL.
2. (U) SCHEDULE CHANGES: Delay in award of the Follow-On Architecture Analysis Contract to FY90; delay of manpower & standardization studies to FY90; delay of the Large Optics MODIL to FY91.
3. (U) COST CHANGES: NONE.

F. (U) PROGRAM DOCUMENTATION:

o (U) System Concept Paper (SCP)	Aug 87
o (U) Test and Evaluation Master Plan (TEMP)	Jun 87
o (U) Program Master Plan (PMP)	Jun 87
o (U) Environmental Impact Analysis Process Framework	Sep 87
o (U) Concept of Operations (CONOPS)	Oct 88

G. (U) RELATED ACTIVITIES:

- o (U) Program Element 060322C, Surveillance, Acquisition, Tracking, and Kill Assessment (SATKA);
- o (U) Program Element 0603221C, Directed Energy Weapons (DEW);
- o (U) Program Element #0603222C, Kinetic Energy Weapons (KEW);

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project Number: 40
Budget Activity: 02
Advanced Technology Development

- c (U) Program Element 0603224C, Survivability, Lethality, & Key Technologies (SLKT);
- c (U) Element technology work feeds architecture analysis with empirical data;
- 0 (U) Element design concepts are influenced by Engineering and Support inputs;
- c (U) There is no unnecessary duplication of effort within the Department of Defense.

H. (U) OTHER APPROPRIATION FUNDS: NONE.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: NONE.

J. (U) MILESTONE SCHEDULE:

c (U) SDS Phase I IRR	2/89			
c (U) Implement MCDIL	4/88	3/89	3/90	2/91
c (U) NSITE Experiments	4/88	4/89		
c (U) EIS for Kwajalein Atoll	4/89			
c (U) Comprehensive Space Model	4/89			
o (U) Follow-On Architecture Contract	1/90			
c (U) SDS Phase I SRR	2/90			
c (U) Validate SDS Follow-On Functions	2/90			

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603173C
PE Title: Systems Analysis & Battle Management (U)
Project Number: 42
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)

Project Title / Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY 91 Est	To Comp	Total Program
Theater Defense	50,500	30,605	48,922	46,270	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The Theater Defense effort combines architecture studies, technology development tests, and test bed development to form the cornerstone of an essential layer in the development of a global defense against ballistic missiles. This project defines the mission objectives and derives candidate architectures for NATO, the Middle East, the Western Pacific Basin, and other theaters against the threat of theater ballistic missiles (TBM).

Concept definition and architecture studies are conducted through government to government agreements with our Allies, and through US-managed procurements with multinational contractor consortia. These studies address candidate architectures, resultant technology requirements, interfaces with existing defensive capabilities, and technology risks within current allied and American technology programs. These technology requirements are then examined in various hardware test activities.

Additionally, this effort directs the emerging Theater Test Bed program which will develop the capability to simulate and evaluate the contribution of various theater architecture systems/elements to a layered defense. The test bed will be capable of executing parametric studies and trade-off analyses to support the design and development of performance requirements for TMD systems and elements.

The principal goal the the Theater Defense project is to focus theater missile defense activities in a coherent and comprehensive manner to drive the development and exploitation of necessary technologies.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

o (U) Developed five near-term (before 1995) candidate theater missile defense architectures for the defense of NATO, to include A-Level specifications of architectures.

o (U) Evaluated the five candidate architectures for the defense of NATO in light of the Post-Intermediate Nuclear Force (INF) agreement.

o (U) Initiated a study addressing the applicability of Directed Energy Weapons in a NATO TMD role.

o (U) Developed technical design and performance requirements.

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

o (U) Developed United Kingdom and Israeli architectures to address specific regional issues and technology requirements. The UK Architecture Study proposed a mid-term (2010) architecture for European missile defense. Additionally, this study identified several critical technology issues whose resolution will be accomplished on a cooperative cost sharing basis.

o (U) Developed requirements and defined the test bed configuration for a man-in-the-loop facility, and test plans for an Israeli TMD BM/C3 test bed.

o (U) Synthetic Aperture Radar Addition Holography (SARAH) project examined the feasibility of employing space-based sensors in support of theater missile defenses.

o (U) Completed the initial phases of a project which examines the potential benefits and interface opportunities between a deployed strategic defense system and theater missile defenses.

o (U) Initiated a Western Pacific (WESTPAC) architecture study to examine the defense of the Western Pacific against tactical ballistic missiles.

2. (U) FY 1989 Planned Program

o (U) Develop long term (beyond 1995) theater missile defense architectures for NATO and the Western Pacific regions.

o (U) Develop a test bed capability to support evaluations and experiments in a controlled environment in the Middle East and Europe.

o (U) Begin development of the UK Node of the Extended Air Defense Test Bed.

o (U) Develop a prototype demonstrator employing artificial intelligence techniques for discriminating theater missile threats.

o (U) Examine the human-machine interface with respect to computer applications in a theater command and control environment.

o (U) Examine the utility and technical feasibility of employing an airborne high energy laser as an element of a TMD system.

3. (U) FY 1990/1991 Planned Program

o (U) Continue development of artificial intelligence devices to discriminate theater missile threats.

o (U) Continue work in architect development for NATO and WESTPAC regions.

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

c (U) Develop European and Israeli test beds to support experiments in a controlled environment.

c (U) Continue examination of employing an airborne high energy laser as an element of a TMD system.

4. (U) Program to Completion This is a continuing program.

D. (U) WORK PERFORMED BY:

- c Hughes Aircraft Corporation, Fullerton, CA.
- c Teledyne Brown Engineering, Huntsville, AL.
- c Sparta, Huntsville, AL.
- c Riverside Research Institute, Arlington, VA.
- c Nichols Research Corp., Huntsville, AL.
- c New York Polytechnic Institute, New York, NY.
- c LTV Missiles and Electronics Group, Dallas, TX.
- c Mitsubishi Heavy Industry, Japan.
- c MBB Federal Republic of Germany.
- c SNIA BPD, Italy.
- c CoSyDe, France.
- c Tadiran, Israel
- c Royal Signals and Radar Establishment, United Kingdom.
- c UK Ministry of Defense
- c IS Ministry of Defense

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY: IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: None
2. SCHEDULE CHANGES: None
3. COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION: Several SDIO Work Package Directives and their implementing guidance. Final Reports from various architecture studies.

G. (U) RELATED ACTIVITIES: Theatre Defense also appears as Project 42 in Program Element 0603222C, Kinetic Energy Weapons.

H. (U) OTHER APPROPRIATION FUNDS: None

Program Element: 0603222C
PE Title: Systems Analysis & Battle Management (U)

Project Number: 42
Budget Activity: 02
Advanced Technology Development

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: MCU's exist between the United States and the United Kingdom, West Germany, Italy, France, Japan, and Israel.

J. (U) MILESTONE SCHEDULE:

o WESTPAC	
Master Schedule an Work Break Down Structure	1Q89
In Progress Review	3Q89
Threat Characterization and Scenarios	3Q89
Missile Defense Definition and Measures of	3Q89
Effectiveness Progress Report and Briefing	3Q89
Option Study Plan	4Q89
In Progress Review	1Q90
Cost Assessment	1Q90
Experiment/Demonstration Report	1Q90
Innovation Report	1Q90
Final Report	1Q90
o Prototype Artificial Discriminator	
In Progress Review	1Q89
In Progress Review	4Q89
Final Report	4Q89
o Man-Machine Interface	
Project Start	2Q89
In Progress Review	3Q89
Final Report	4Q89
o Theater Coupling Task	
Technical Requirements Plan	1Q89
In Progress Review	1Q89
Final Report	2Q89
o TMDAS	
Near term Post-INF Architecture Defined	3Q89
Technical Experiments Purposed and Defined	3Q89
o Israeli Test Bed	
Contract Award	2Q89
Design of Test Bed Complete	4Q90
Test Bed Operational Capability	3Q91
o Theater Test Bed	
UK Node Design Concept	2Q89
Award US Node Contract	3Q89
Extended Air Defense Test Bed Functional Design	1Q90
Huntsville, AL. Node Operational	3Q91
Ft Bliss, TX. Node Operational	3Q91
UK Node Operational	3Q91
Other Nodes Operational	4Q91

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)
Project: 43
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES: ($ in Thousands)

Project Title:
Command Center/System Operation & Integration Functions (CC/SOIF) (U)

Popular Title:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
BM/C3 Technology (U)	64,306	59,000	86,500	108,000	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES

(U) This project develops technologies required to support responsive, reliable, survivable CC/SOIF ballistic missile defense. Five technology tasks exist:

(U) TASK 1. BATTLE MANAGEMENT ALGORITHMS: Development of battle management algorithms that are responsive to the CC/SOIF architecture requirements developed in the CC/SOIF Experimental Systems Project.

(U) TASK 2. NETWORK CONCEPTS: Development of battle management/C3 networks responsive to the CC/SOIF architecture requirements developed in the CC/SOIF Experimental Systems project.

(U) TASK 3. PROCESSORS: Development of information processing technology, devices, and subsystems that are secure, high-performance, fault-tolerant, space qualified, and hardened to withstand hostile environments. This task also includes the development of operating systems, executive, and file management software and firmware that is indigenous to the local processing environment. This task area responds to the requirement to implement battle management algorithms and C3 networks, as described earlier.

(U) TASK 4. COMMUNICATIONS: Development of communications technology, devices and subsystems that are secure and robust, to support multi-mode/multi-media mission required data rates for the several alternative defensive architectures, their evolutions and variations. This task also includes the development of embedded software and hardware indigenous to the communications environment.

(U) TASK 5. SOFTWARE ENGINEERING: Creation of secure SDI Software Development Environments that provide the capability to produce software with the requisite productivity and quality. A near term capability is needed both to support the CC/SOIF Experimental Systems Project (though this may be provided by the industrial sector) and to support a potential defensive system.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY1988 Accomplishments:

- (U) The ENCORE program to develop fault tolerant computing capability has completed the evaluation phase.

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project: 43
Budget Activity: 02 Advanced Technology Development (U)

- (U) Advances were made in 60 GHz Traveling Wave Tube Amplifiers.
- (U) The Distributed Computing Design System (DCDS) environment contributed to the success of the EV-38 Levels 0 and 1 experiments.

2. (U) FY1989 Planned Program:

- (U) Algorithms: Focus on developing tracking and discrimination algorithms.
- (U) Networks: Focus on communications security to develop requirements and a testbed (CCMSEC) for a secure architecture.
- (U) Processor: Continue investigating promising parallel architectures to select the best for insertion into the CC/SOIF Experimental Program.
- (U) Communications: Research is directed to developing a multiple beam 60 GHz antenna to support the system design concept.
- (U) Software Engineering: Research will continue in developing operating systems and compilers for parallel processor architectures.

3. (U) FY1990 Planned Program:

- (U) Previous efforts will lead to advanced performance in areas, such as packet switching techniques, agile beam communications antennas, and adaptable software tools for improved productivity.
- (U) Improved battle management algorithms will be delivered, evaluated, and inserted into the CC/SOIF Experimental Program.
- (U) Programming environments for parallel processors will be tested and evaluated for promising parallel processor architectures.
- (U) Laser communications pointing, acquisition and tracking advanced development model hardware will be completed and integration of a space-based laser communication subsystem prototype will commence.

4. (U) FY1991 Planned Program:

- (U) Advanced algorithms will be transitioned to the National Test Bed.

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 50
Budget Activity: 02 Advanced Technology Development

Materials Development, Advanced Space System Hardening (ASSH), LHMEL Development, and Defensive Shields Program.

- -(U) Nuclear Hardening: Necessary Analysis/AGT for Disko Elm/Mineral Quarry UGTs, C3 Survivability - RF Propagation, Focal Plane Array (FPA) Hardening, Advanced Energy Sharing Development - Optics, Advanced Component Evaluations/Characterizations - FPA, Electronics, etc.
- -(U) High-Power Microwave (HPM) and Neutral Particle Beam (NPB) Survivability: Threat Environment Assessment; Susceptibility Measurements; Sensor Vulnerability/Hardening.
- -(U) Active Survivability Technology: decoys, ECM/CCM.

o (U) Initiate technology efforts for Phase II systems and threats

- -(U) Phase II-specific threat definition: DANASAT force numbers; Soviet location and tracking capabilities; ASAT homing capabilities; EW, HPM, and NPB threats.
- -(U) Survivability technologies for Phase II: HEDI, AOS, NPB, GBL, SBL.

(U) FY 1991 Planned Program:

- o (U) Continue efforts from the FY 1990 Project to support Phase I technology requirements.
- o (U) Address funding and/or technology/survivability shortfalls from the FY 1989/90 Projects.
- o (U) Continue technology efforts for Phase II systems (HEDI, AOS, NPB, GBL, SBL) and defense suppression threats (DSTs: Phase I plus EW, HPM, NPB).
- o (U) Continue evaluation of radiation and electromagnetic effects on ERIS and GSTS vehicle structures and electronic components.
- o (U) Undertake major component/subsystem level validation test program of survivability enhancement.
- o (U) Conduct INSURE experiments.

(U) Project to Completion: This is a continuing program. As Phase I technology goals are realized in FY 1991/92 and these technologies are infused into the development program, the emphasis will gradually shift towards validation and assessment. Additionally, the project will begin to address Phase II Elements technology needs to survive the evolving SDS defense suppression threat.

D. (U) WORK PERFORMED BY:

Rockwell International, Anaheim, CA
TEXTRON Specialty Materials, Inc., Boston, MA
Computer Sciences Corporation, Inc., Falls Church, VA
Nichols Research Corp., Huntsville, AL
ACUREX, Inc., Dayton, OH
Air Force Space Division
Air Force Weapons Laboratory
Air Force Wright Aeronautical Laboratory
United States Army Strategic Defense Command

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 50
Budget Activity: 02 Advanced Technology Development

E. (U) COMPARISON WITH FY 1989 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES (U)

(U) The Survivability Project focus has changed significantly since the FY 88 Descriptive Summary submission. In July 1988, many of the Survivability programs were transferred to program element and technology specific programs. This change was made to ensure that those responsible for specific technology or element development also be responsible for ensuring that it can survive. Therefore, the FY 89 Program is oriented to developing unique and common (to more than one element) survivability technologies in the areas of passive and active technologies. At the same time, the Survivability Project budget was reduced by approximately $40 million in FY 89 to accommodate fiscal reductions.

1. (U) TECHNICAL CHANGES: Assuming programs transferred to other SDIO programs are funded and maintain the current technology objects, no significant technical impacts will occur. Fiscal reductions in the those projects that remain in the Survivability Program will be accomplished at considerably higher risk due to funding restrictions.
2. (U) SCHEDULE CHANGES: None.
3. (U) COST CHANGES: None.

F. (U) PROGRAM DOCUMENTATION:

Survivability Implementation Plan	1Q FY 88
SDS Survivability Demonstration Study Plan	3Q FY 88
Survivability Guidelines Documents	1Q FY 90

G. (U) RELATED ACTIVITIES:

Program Element 0603220C, SATKA program
Program Element 0603222C, Kinetic Energy Weapons
Program Element 0603223C, System Analysis, Battle Management, and C3

H. (U) OTHER APPROPRIATION FUNDS: None

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 50
Budget Activity: 02 Advanced Technology Development

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

(U) Under the umbrella of the Memorandum of Understanding between the SDIO and MOD UK, two cooperative programs are underway and are anticipated to continue through FY 1990/91. One effort is conducted within a survivability subgroup of SCORE (SDIO Cooperation Research Exchanges), the other is a program to fund unique laser optics technology capabilities through MOD UK. Work is accomplished in a government laboratory and through four contractors (OCLI, Plessey, Royal College Of Military Science, and GEC). The program, begun in FY 88 will continue through FY 91 at a cost of approximately $2.2 million.

J. (U) MILESTONE SCHEDULE:

Defense Suppression Threat Defined	4Q FY 88
System Level Survivability Requirements	3Q FY 89
Element Level Survivability Requirements	3Q FY 89
Diske Elm UGT	4Q FY 89
Mineral Quarry UGT	3Q FY 90

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C (U)
PE Title: Key Technologies
Project Number: 51 (U)
Budget Activity: 02 Advanced Technology Development (U)

A. (U) RESOURCES ($ in Thousands)
Project Title Lethality and Target Hardening (LTH)

Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
LTH (U)	68,641	62,218	124,434	152,128	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

There are large uncertainties in our knowledge of candidate SDI weapon effects. This is due to the new physical principles and performance regimes of these weapons and the limited knowledge we have of the characteristics of strategic targets. Some of the characteristics of these targets are merely postulated as elements of the retrofit or responsive threat. The Lethality and Target Hardening (LTH) project addresses the important issues of weapon effectiveness and weapon-target interaction signatures (observables). Put simply, this project answers two questions, "What does it take to kill the target?" and "What could be seen when the target is hit or killed?" It is a comprehensive research program that studies damage-effects created by SDI weapon concepts and predicts the corresponding vulnerability of Soviet targets. Current lethality work includes both kinetic energy weapons and directed energy weapons (lasers and particle beams). It includes the study of weapon (probe)-target interaction effects and signatures that may be useful for interactive discrimination of reentry vehicles from decoys and space junk. The LTH project also studies material hardening from the Soviet perspective (hardening of offensive systems). It determines potential hardening levels and tests these levels against SDI weapons concepts. The basic goal of this program is to provide essential data for weapon system design such that both large "safe-side" overdesign and accidental catastrophic underdesign can be avoided. As such, it is a "high leverage" program.

C. PROGRAM ACCOMPLISHMENT AND PLANS (U):

FY 1988 Accomplishments:

c (U) Experiments to compare radio frequency (RF) and induction (IN) linear accelerator free electron laser (FEL) lethality have been completed. Analysis will be complete in first quarter FY89.

c (U) Lethality criteria for booster kills by x-ray lasers have been produced.

c (U) Initial interactive discrimination signatures for thermal lasers were taken and results are promising.

c (U) Particle beam lethality was demonstrated against inertial measurement units and safing, arming, fuzing, and firing (SAFF) packages. A preliminary interactive discrimination assessment was produced for particle beam weapons.

Program Element: 0603314C (U)
PE Title: Key Technologies

Project Number: 51 (U)
Budget Activity: 02 Advanced Technology Development (U)

c (U) Initial lethality criteria for tactical chemical and conventional warheads were developed.

c (U) Criteria to evaluate kinetic energy weapon lethality enhancers has been provided to the HEDI, ERIS, and SBI offices.

FY 1989 Planned Program:

c (U) The thermal laser lethality program will conduct high intensity testing of hardened materials and hardening concepts, large scale testing of hardened boosters, lethality comparison of the RF and induction LINAC FELs, and ground testing in support of Zenith Star target development and discrimination signatures.

c (U) The single pulse laser lethality program will continue development and validation of instrumentation for underground tests, and conduct testing of the coupling of laser energy to targets on the NOVA laser.

c (U) The neutral particle beam lethality program will include testing of decoys designed to countermeasure NPB discrimination, continuation of neutron return signature testing and analysis, and assessment of the lethality of NPBs against unhardened PBVs and RVs.

c (U) The kinetic energy lethality program will encompass determination of the number of RVs destroyed by initiating energetic materials aboard targeted PBVs, boosters or RVs, and aerothermal/structural testing to define minimum lethal damage. Theater missile defense lethality efforts will concentrate on chemical and conventional warheads.

FY 1990 Planned Program:

c (U) The thermal laser lethality program will accomplish testing of high irradiance hardened materials and hardened boosters, analyze and test post boost vehicles, defense suppression weapons and decoys, and characterize discrimination signatures of decoy materials.

c (U) The single pulse laser lethality program will continue development and validation of diagnostics for underground testing, and begin investigation of new booster kill mechanisms.

c (U) The neutral particle beam lethality program will complete bipolar electronics and structural failure criteria, continue work on the safing, arming, fuzing, and firing package in RVs, and provide discrimination criteria for the moderate (10%) decoy.

Program Element: 0603224C (U)
PE Title: Key Technologies

Project Number: 51 (U)
Budget Activity: 02 Advanced Technology Development (U)

o (U) The kinetic energy lethality program will validate criteria for lightweight membrane enhancers, continue work on vaporization from high velocity impacts and aerothermal/structural (ATS) kill mechanisms, provide final mission kill criteria for chemical TMD targets, and continue to support HEDI/ERIS flight tests.

FY 1991 Planned Program:

o (U) In the thermal laser lethality program, complete the large scale testing of hardened solid boosters, and begin large scale testing of hardened PBV and defense suppression weapons.

o (U) In the single pulse laser lethality program, validate lethality effects in weapon environments, and upgrade lethality criteria utilizing simulations based on the results of weapon environment testing.

o (U) In the neutral particle beam lethality effort, begin testing of advanced electronics, investigate use of other beam particles (i.e. lithium, deuterium) and begin work on light decoy discrimination countermeasures.

o (U) In the kinetic energy lethality program, continue work on vaporization and ATS kill mechanisms, continue assessment of hard kill of chemical targets and begin nuclear targets for TMD lethality. We also plan to participate in the scheduled ERIS/HEDI flight tests to validate algorithms and provide an independent assessment to SDIO, and to provide lethality support to the TMD Invite Show and Test Program.

PROGRAM TO COMPLETION (U): This is a continuing program.

D. (U) WORK PERFORMED BY:
The Defense Nuclear Agency (DNA) is the executing agent. The individual managers are located in DNA, and in the U.S. Army Strategic Defense Command, the U.S. Air Force Weapons Laboratory, and the U.S. Air Force Armaments Test Laboratory. Other government organizations include the U.S. Air Force Wright Aeronautical Laboratory, the DoD High Energy Laser Systems Test Facility, the Los Alamos National Laboratory, the Lawrence Livermore National Laboratory, the Sandia National Laboratory, the Brookhaven National Laboratory and the Battelle National Laboratory. Principal contractors include Lockheed Missiles & Space Corp., Sunnyvale, CA, McDonnell Douglas Astronautics Corp., Huntington Beach, CA, TRW, Inc., Redondo Beach, CA, Westinghouse, Inc., Pittsburgh, PA, Kaman Sciences Corp., Colorado Springs, CO, Acurex, Inc., Dayton, Ohio, and General Research Corp., Santa Barbara, CA.

Program Element: 0603224C (U)
PE Title: Key Technologies

Project Number: 51 (U)
Budget Activity: 02 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	De-optimized	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

(U) Narrative Description of Changes:

1. (U) TECHNICAL CHANGES: Current follow-on SDS systems will not be optimized for lethality. Lethality of innovative systems will not be addressed.
2. (U) SCHEDULE CHANGES: Phase I SDS milestones will be met, however, follow-on SDS milestones will be supported by non-optimal lethality criteria.
3. (U) COST CHANGES: Individual efforts have been delayed to conform to the reduced funds appropriated for FY 89.

F. (U) PROGRAM DOCUMENTATION: Technical Requirements Document (TRD) - 1988 Lethality Assessment documents (1985 and 1987)

G. (U) RELATED ACTIVITIES: This project conducts analyses and experiments to produce essential data for decisions on weapons, sensors, and SDS architectures that must be made in SDI Program Elements 0603220C, Sensors; 0603221C, Kinetic Energy Weapons; 0603222C, Directed Energy Weapons; and 0603223C, Systems Analysis, Battle Management, and C^3.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. MILESTONE SCHEDULE (U):

CW Laser Lethality (U):

(U)	- Provide CW laser lethality data for hardened solid ICBMs.	4Q FY 91
(U)	- Provide CW laser lethality data for fast burn solid booster.	2Q FY 90

Single Pulse Laser Lethality (U):

(U)	- Validate lethality potential	4Q FY 91

Particle Beam Lethality (U):

(U)	- Test moderate Decoy signature for interactive discrimination.	3Q FY 89
(U)	- Complete development of lethality criteria for baseline targets.	4Q FY 90
(U)	- Complete development of lethality criteria for retrofit hardened targets.	3Q FY 91
(U)	- Complete development of lethality criteria for interactive discrimination of light and heavy decoys.	3Q FY 92
(U)	- Complete development of lethality criteria for responsively	3Q FY 93

Program Element: 0603224C (U)
PE Title: Key Technologies

Project Number: 51 (U)
Budget Activity: 02 Advanced Technology Development (U)

hardened targets.

Kinetic Energy Weapons Lethality (U):

(U)	- Complete experiments with high velocity membrane enhancer.	3Q FY 90
(U)	- Complete propellant initiation experiment.	3Q FY 89
(U)	- Complete Aerothermal/Structural Kill Reentry Experiment #2.	3Q FY 90
(U)	- Complete lethality criteria for direct kill.	3Q FY 92

Repetitively Pulsed Laser Lethality (U):

(U)	- Provide assessment of RF and Induction LINAC lethality	2Q FY 89
(U)	- Provide initial assessment of innovative hardening materials.	4Q FY 90
(U)	- Provide lethality criteria for responsive target designs.	2Q FY 91

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C (U)
PE Title: Key Technologies (U)

Project Number: 52 (U)
Budget Activity 02 Advanced Technology Development (U)

A. (U) RESOURCES ($ in Thousands)
Project Title Power and Power Conditioning

Popular Name	FY88 Actual	FY89 Actual	FY90 Estimate	FY 91 Estimate	To Complete	Total Program
Power	97,204	99,509	205,295	236,979	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
(U) The Power program was established to develop power generation and conditioning technologies capable of producing large quantities of specially conditioned electrical power required by advanced kinetic/directed energy weapons and space-based surveillance and BM/C3 systems. Power requirements for the various SDIO payloads are divided into two broad categories: (1) baseload power for surveillance, communication and housekeeping applications; (2) burst power for weapons and discrimination operation, and periodic testing. General categories in the program include baseload power, multimegawatt technology, pulse power conditioning, and assessment and analysis.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY88 Accomplishments:

(U) System Design Review of the SP-100 Ground Engineering System (GES) conducted. The fuel production facility at LANL was qualified and fuel shipped to Hanford for assembly into the Nuclear Assembly Test (NAT) unit.
(U) Six Nuclear Multimegawatt (MMW) concept development studies initiated. Technology support efforts at selected National Laboratories.
(U) Downselection to perform technology assessments and critical experiments to determine viability of MHD as space-based power system.
(U) Major advances in RF tube and solid state technologies: Tested the first high power (500 kW) Klystrode, and a 300 W Static Induction Transistor (SIT).
(U) Four contracts were initiated to begin the development of a Survivable Solar Power (SUPER) subsystem.
(U) Validation of fuel cell electrochemistries for lightweight, high power module demonstration.
(U) Initiation of the Superconducting Magnetic Energy Storage (SMES) program to conduct competitive design studies for an Engineering Test Model (ETM).

(U) FY89 Program Plan:

(U) Downselect to two Nuclear MMW three-year detailed concept development and preliminary design efforts.
(U) The SMES ETM site recommendations to be reviewed and accepted for each team. Testing of critical components and technologies will continue.
(U) Continue RF technology development: Integrate 425 MHz SIT's to develop a 50 kW amplifier package. Develop higher power Rf tubes.
(U) Laser and radiation hardness tests will be completed on the Survivable Concentrator Photovoltaic Array (SCCPA) programs.

Program Element: 0603224C (U)
PE Title: Key Technologies (U)

Project Number: 52 (U)
Budget Activity 02 Advanced Technology Development (U)

(U) High power density fuel cell and battery demonstrations of 50 kW modules will occur, with scalability to MMW applications.
(U) Multiple contracts will be initiated for the design and construction of an NPB power system to demonstrate feasibility and technology readiness.

(U) FY90 Program Plan:

(U) Downselection to a single SMES contractor to build the ETM demonstration unit.
(U) Analyses of high power systems in the space environment completed.
(U) Downselection for construction of the dem/val MHD unit.
(U) Complete 20 MW superconducting generator full prime power tests.
(U) SCOPA design/development completed.
(U) Fabrication and test of the 40 MW high voltage alternator rotor.

(U) FY91 Program Plan:

(U) Construction of the SMES demonstration unit will begin.
(U) Nuclear MMW detailed concept and preliminary design work will continue.
(U) Continue SCOPA flight demonstration module for anticipated FY1992 launch.
(U) Demonstration of 50 kW battery and fuel cell modules.
(U) Downselects for construction of the NPB power system demo.
(U) Downselects for SUPER final design and critical component testing.
(U) Complete testing of 40 MW high voltage hyperconducting alternator.

(U) Program to Completion:

(U) This is a continuing program. As technology feasibility is established, a transition will be made from a large number of small technology efforts to a small number of high power system demonstration programs to verify the feasibility and technology readiness for SDIO continuous and burst power requirements.

D. (U) WORK PERFORMED BY:

(U) There are 14 Work Package Directives (WPD) within the Power program. The Department of Energy: SP-100 Ground Engineering System and Nuclear Multimegawatt programs. Los Alamos National Laboratory: RF Technology. NASA Lewis Research Center: Space Environment Modeling. The Air Force Wright Aeronautical Laboratory: Advanced Solar and Non-Nuclear Multimegawatt Power Technologies. The Defense Nuclear Agency: Pulse Power and Power Conditioning and SMES. The Army Strategic Defense Command: Neutral Particle Beam Power System Demonstrator.
(U) Principal industrial contractors include: General Electric, Valley Forge, PA; Ebasco, New York, NY; Bechtel, San Francisco, CA; Hughes Aircraft, Torrance, CA; and UTC, South Windsor, CT.

Program Element: 0603224C (U)
PE Title: Key Technologies (U)

Project Number: 52 (U)
Budget Activity 02 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	Increased
Cost	Reduced	Delayed	N/A

(U) Because of SDIO budget cuts, the SP-100 Ground Engineering System (GES) has been slowed, delaying full-scale demonstration of the GES and flight demonstration. SP-100 is considered the principal baseload power source for SDIO Phase II missions.

(U) Because of SDIO budget cuts, the demonstration of the SMES ETM has been rescheduled to 1994.

(U) The NPB Power System Demonstrator has rescheduled its start date to FY89 due to unexpected difficulties in the Army procurement process.

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: None.

2. SCHEDULE CHANGES: Flight demonstration of SP-100 has had to be rescheduled to the mid 1990's. Demonstration of the SMES ETM has also been rescheduled to 1994. SMES is a potential option to power ground-based lasers.

3. COST CHANGES: The total contribution from the three funding agencies (DoD-SDIO, NASA, DOE) for SP-100 originally programed at $100 M has been reduced. Major program restructuring in FY89 and FY90 will increase total program cost.

F. (U) PROGRAM DOCUMENTATION:

- (U) Power Source and Power Conditioning Subsystems Requirements Guidelines, Sandia National Laboratory, Draft 1988.
- (U) The Effect of Operating Temperature on Open MMW Space Power Systems, SAND86-1813, Sandia National Laboratory.

G. (U) RELATED ACTIVITIES: This project provides essential data for decisions on weapons, sensors, and strategic defense system architectures funded in:

- (U) Program Element 0603220C, Surveilance, Acquisition, Tracking and Kill Assessment.
- (U) Program Element 0603211C, Directed Energy Weapons.
- (U) Program Element 0603222C, Kinetic Energy Weapons.
- (U) Program Element 0603223C, Systems Analysis, Battle Management, and Command, Control and Communications.

H. (U) OTHER APPROPRIATION FUNDS: None

Program Element: 0603224C (U)
PE Title: Key Technologies (U)

Project Number: 52 (U)
Budget Activity 02 Advanced Technology Development (U)

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS:

c (U) Ansaldo, Genoa, Italy: $55K with DOE as agent to investigate a gas core nuclear reactor for an MHD system; $520K contract with the Air Force as agent to develop inductive energy storage capabilities; $20K contract with to develop current leads for the SMES program.

c (U) Solmecs, Beer Sheva, Israel: $150K with DOE as agent to assess the feasibility of Cesium removal from an MHD exhaust.

c (U) Thomson CSF, Bonlogue-Billaucourt Sedex, France: $500K contract, Los Alamos National Laboratory as agent to improve RF accelerator performance.

c (U) English Electric Valve, Chelmsford, England: $1,100K contract with the Defense Nuclear Agency as agent for Megawatt average power thyratrons.

c (U) SDIC/SLKT has established a cooperative technology exchange effort with the United Kingdom Ministry of Defense to discuss power/power conditioning technological advances.

J. (U) MILESTONE SCHEDULE:

(U)	SP-100	
	Begin Fabrication of GES	FY 1990
	Begin Reactor Testing	FY 1993
	Complete Reactor Testing, Design Verification	FY 1994
(U)	Advanced Solar	
	SUPER Concept selection	FY 1989
	SCCPA Development Complete	FY 1990
	SUPER Test/Development Complete	FY 1992
(U)	Nuclear MMW	
	Evaluate Pre-Concepts/Downselect to 2 Concepts	FY 1989
	Downselect to one MMW Concept	FY 1993
(U)	SMES	
	Final downselect/Begin ETM Construction	FY 1990
	ETM Construction Completed	FY 1993
	Test and Evaluation	FY 1994
(U)	NPB Power System Demo	
	3 Preliminary Design Contracts Awarded	FY 1989
	Initiate Hardware Development and Fabrication	FY 1991
	Hardware Testing Complete/Delivery	FY 1994

FY 1990/91 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C
PE Title: Key Technologies
Project Title: Space Transportation

Project: 53
Budget Activity: 02 Advanced Technology Development

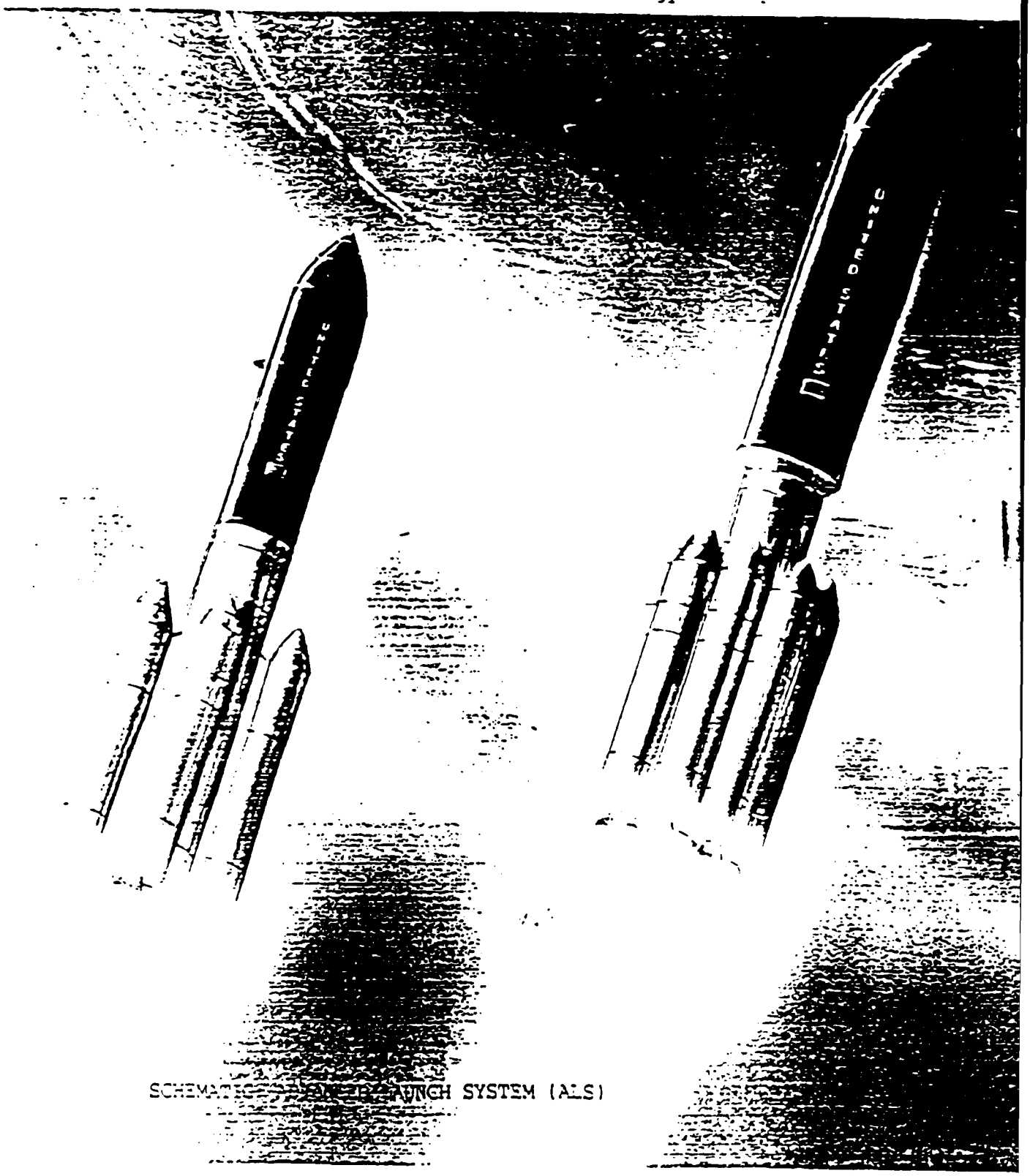
Picture/Schematic: See Next Page

Popular Name: Advanced Launch System

A. (U) SCHEDULE/BUDGET INFORMATION ($ in Thousands):

SCHEDULE	FY 88	FY 89	FY 90	FY 91	TO COMPLETE
Program Milestones	M/S 0 9/88	-	M/S I 2QFY90	-	M/S II & III FY92 & 93
Engineering Milestones	SDR-6/88	DELTA SDR 3QFY89	PDR-3QFY90	-	CDR-TBD
T&E Milestones	-	TEMP	TBD	TBD	TBD
Contract Milestones	-	PHASE II 12/88	-	-	FSD/PHASE III 1QFY93
BUDGET	FY 88	FY 89	FY 90	FY 91	Prog Total
Major Contract	8,000	32,700	70,000	74,750	Continuing
Support Contract (TECH)	61,500	4,500	44,500	69,500	Continuing
JPO/Other	10,500	17,800	10,309	10,500	Continuing
NASA	-	96,500**	-	-	Continuing
Total	79,558	151,500	124,809*	154,750*	Continuing

* USAF provides additional funding FY90 and beyond.
** Direct transfer to NASA; congressional fence.



SCHEMATIC OF ADVANCED LAUNCH SYSTEM (ALS)

Program Element: 0603224C
PE Title: Key Technologies

Project: 53
Budget Activity: 02 Advanced Technology Development

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
(U) Recent launch failures, an outdated space transportation technology base, diminished launch capacity, and high space trans-portation costs have seriously undermined America's ability to access space. To economically meet the growing space launch requirements of the 1990s and beyond, a system is needed which will provide low cost, reliable, high capacity, and operationally flexible access to space. The objective of the Advanced Launch System (ALS) is to define a system which is capable of satisfying the launch requirements of all users, including DOD, NASA, civil and scientific sectors, by the turn of the century with a goal of a ten-fold reduction in the cost to deliver cargo to low earth orbit as compared to the present day cost of the Titan IV. The payload capacity of the ALS will be determined at the ALS Defense Acquisition Board Milestone I Review currently scheduled for 2QFY90. However, the ALS must have the ability, either initially or through clearly defined engineering growth, to deliver payloads of 100,000 kg to a 80x150 nmi, 28.5 degree reference orbit. Also, the ALS must be able to meet potential expanded mission models of over 1M kg by the early 2000s. Beginning in FY 90, this program will also include funding for on-orbit vehicle and technology development required for future deployments.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1988 Accomplishments:

- Midterm Design Review 4/88.
- System Design Review 6/88.
- DAB M/S 0 complete 9/88.
- Phase I Complete 9/88--Concept Definition.
- Propulsion facilities begin refurbishment for ALS engine tests.

(U) FY 1989 PLANNED PROGRAM:

c Phase II, Concept Validation, will continue with emphasis on hardware validation of the system, core engine, and booster engine (motor).

c Increased emphasis on following technologies: low cost LOX/H_2 engine, low cost clean solids, expert system applications, vehicle health monitoring, cryogenic tanks, ground operations, and manufacturing technology.

c Preliminary design of the components of the LOX/H2 engine should be completed in mid FY89, components of the vehicle health monitoring system should be defined mid FY89, manufacturing process demonstration should occur late FY89 and improved formulations for solid propellants should occur in late FY89.

(U) FY 1990 PLANNED PROGRAM:

- Continue FY1989 efforts leading to DAB Milestone I decision, 2QFY90.
- Definition of on-orbit space operations requirements.

Program Element: 0603224C
PE Title: Key Technologies

Project: 53
Budget Activity: 02 Advanced Technology Development

(U) FY 1991 PLANNED PROGRAM:

- c Technology Demonstrations completed 4QFY91.
- c Improved manufacturing processes -- 4QFY91.
- c On-orbit operations technology development.

(U) Program Plan to Completion:

- c DAB Milestone II 3QFY92
- c FSD GO AHEAD 1QFY93
- c CDR is planned for 4QFY94
- c ILC is planned for FY1998
- c ICC is planned for FY2000

D. (U) WORK PERFORMED BY:

(U) For Phase II, Concept Validation, the three contractors will be Boeing, Seattle, Wash., General Dynamics Space Systems Group, San Diego, CA, and Martin Marietta Astronautics Group, Denver,CO. Each contractor is responsible for specific technology demonstrations. Another open competition will be held for Phase III, Full-Scale Development.

(U) Daily management of the ALS program is performed through a joint DOD/NASA ALS Program Office. The Program Office makes the best use of both DOD and NASA expertise and facilities. ALS SPO is headed by a Program Manager (PM) appointed by the DOD. The Deputy PM was appointed by NASA.

(U) ALS technology spin-offs are encouraged to be incorporated in existing launch systems. However, the benefiting launch system will have to absorb the costs associated with the spin-offs.

(U) Propulsion related technology developments are managed by NASA's Marshall Space Flight Center (MSFC) with the work being performed by contractors, MSFC, Stennis Space Center, and Air Force Astronautics Laboratories.

E. (U) COMPARISON WITH FY 1989 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	FY 90	COST
TECH	-	-	-	-
SCHED	ICC Slips to FY2000	-	TBD	TBD
COST	No current funding for FSD			

Program Element: 0603224C
PE Title: Key Technologies

Project: 53
Budget Activity: 02 Advanced Technology Development

(U) NARRATIVE DESCRIPTION OF CHANGES:

1. (U) TECHNICAL CHANGES: NONE
2. (U) SCHEDULE CHANGES: Program is currently funded only through Phase II, Concept Validation. Lack of funding for FSD and production means that the ICC will slip to 2000 as currently planned. Required funding for FSD and Production is TBD.
3. (U) COST CHANGES: NONE

F. (U) PROGRAM DOCUMENTATION:

- o Statement of Need 8/88
- 0 Mission Need Statement 11/88

G. (U) RELATED ACTIVITIES:

- o ALS program is a joint DOD/NASA effort.
- o Joint use of DOD and NASA expertise and facilities.
- o Air Force provides matching funding beginning in FY90.
- o Technology programs are coordinated between the SDIO and other DOD and NASA agencies including the National to preclude duplication of effort.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) TEST AND EVALUATION DATA: Test and Evaluation Plan completed and in service coordination.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C
PE Title: Key Technologies Technology Development
Project Number: 54
Budget Activity: 02 Advanced

A. (U) RESOURCES: ($ in Thousands)
Project Title: Materials and Structures

Popular Name	FY88 Actual	FY89 Estimate	FY90 Estimate	FY91 Estimate	To Comp	Total Prog
Materials & Structures	24,890	30,731	68,428	86,061	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

The Materials and Structures (M&S Project) conducts research in lightweight structural materials, high temperature superconductivity, tribological, power and optical system materials, and lightweight structures. This work addresses the need for enabling advances in M&S technology to support SDS requirements. The project is focusing on critical path technologies that have multiple SDI systems applications and serve both PHASE I system needs and provides support for advanced mission capabilities.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1988 Accomplishments:

c (U) A materials experiment to measure space environmental effects has been mounted on the Delta Star payload to be launched in FY89. This pioneering experiment will provide the first U.S. telemetered materials data from space.

c (U) Structural damping materials developed as a part of PACOSS experiment activity have been applied to the RME spacecraft to reduce vibrations during launch to acceptable levels.

c (U) Reliable deposition of thin films of High Temperature Superconductivity (HTS) material has been achieved. This important result provides the basis for scaling thin HTS films to large area applications.

c (U) Graphite/aluminum tubes and discontinuous SiC/aluminum end fittings have been fabricated and assembled into a representative space truss structure enabling the structural stiffness required for SDI space platforms.

c (U) The allowable stress in HEDI windows has been doubled by using non-contact ion polishing and ion implantation, increasing reliability.

FY 1989 Planned Program:

c (U) Continuing advances in each of the six M&S major technology areas. The research is structured to provide a balanced effort between PHASE I and follow-on phase system requirements.

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 54
Budget Activity: 02 Advanced Technology Development

o (U) Continued studies of space applicable ultra-low friction lubricants and bearing materials will include demonstration of tribological material advances in a precision sensor gimbal representative of system needs.

o (U) Environmentally stable baffle materials and methods for coating HEDI windows with protective diamond coatings will be emphasized.

o (U) Data on atomic oxygen effects in low earth orbit telemetered from Delta Star will be assessed and distributed for review.

o (U) Lightweight structural composites development will include tests of an interceptor kill vehicle and platform truss for strength, stiffness and dynamic response. A lightweight thermal radiator panel will also be fabricated and tested. Fabrication of tubes and sheets in gauges, sizes and shapes ultimately required for SDS systems will be emphasized.

o (U) Contracts to industry, laboratory and university teams for HTS materials processing and development of proof-of-concept components such as IR detectors, RF cavities and millimeter wave components for phased array antennas will be continued.

FY 1990 Planned Program:

o (U) Technology insertion activities related to Phase I systems will be aggressively pursued while continuing long lead technology advancements for the follow-on phases.

o (U) Test bed demonstrations necessary to achieve transfer of structural and tribological materials advances to space sensor and weapon platforms will be continued. In addition to tests started in FY 1989, demonstrations are planned of advanced composites and advanced tribological materials. A new activity will also be started to develop and demonstrate ultra-low heat leak materials for long term cryogen storage in space.

o (U) Development of HTS devices will increase emphasis on design of proof-of-concept components for SDI systems. Process development of thin films and high current conductor fabrication.

o (U) Development of hardened baffle materials and advanced structural composites for ground based interceptors will continue. Expanded and accelerated materials activities related to kill vehicle thermal control will emphasize heat shields and window cooling.

o (U) A cooperative program will be initiated with NASA to develop durable space materials with emphasis on tests using above ground test facilities to simulate the space environment.

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 54
Budget Activity: 02 Advanced Technology Development

FY 1991 Planned Program:

c (U) Lightweight thermal radiators, surveillance sensor gimbals using long-life tribomaterials, KKV structures, and precision platform ground technology demonstrations will be continued in support of SBI, BSTS, ERIS, SSTS, NPB, SBL, and other SDS systems.

c (U) M&S expects to be substantial participant in the NPB, SSTS and SBL flight demonstration programs, instrumenting the spacecraft for measuring performance and integrating space materials experiments. The M&S Space Environtal Effects Program will be initiating procurement of a dedicated MEO flight experiment to measure on-orbit performance of materials and coating critical to SDS.

c (U) Proof-of-concept tests of an experimental HTS 2x2 IR FPA detector with associated on-array electronics and a RF cavity will be completed.

c (U) An on-going activity will be continued to develop manufacturing methods including materials process scale-up and fabrication techniques to assure acceptance of advanced structural composites by SDI system designers.

Program to Completion: (U) The M&S project in FY 92 and beyond will take to completion all on-going demonstrations and complete the process of technology insertion to the systems designers. Critical technology insertion and processing manufacturability will be completed on all HTS components, Tribo-components and advanced structures technologies.

D. (U) WORK PERFORMED BY: Major performers include Los Alamos National Laboratory, Los Alamos, NM; Oak Ridge National Laboratory, Oak Ridge, TN; Naval Surface Warfare Command, Silver Spring, MD; Langley Research Laboratory, Hampton, VA; Spire Corporation, Bedford, MA; and Boeing Company, Seattle, WA. Principle executing agents are the USA Strategic Defense Command, Huntsville, AL; AF Wright Aeronautical Laboratories, Dayton, CH; Naval Research Laboratory, Washington, DC and the AF Weapons Laboratory, Albuquerque, NM.

E. (U) COMPARISON WITH FY39 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	Reduced	Delayed	+$7M
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 54
Budget Activity: 02 Advanced Technology Development

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: The interrelationship of the space environment with materials to be used in SDS systems has yet to be fully determined. Development of space structure technologies have been severely reduced or eliminated, which greatly increases technical risk in design of advanced space structures required by SDI. Development efforts of some specific technology applications of HTS materials have been reduced, resulting in the possible failure to meet several future mission requirements.
2. (U) SCHEDULE CHANGES: Reduction in FY 89 will delay HTS IR Sensor and MMW components by a minimum of six months to a year. Development of advanced structural materials will be delayed at least a year and possibly longer. Qualification of SDI materials on-orbit will be significantly delayed. Space structures technologies will be delayed 1-2 years.
3. (U) COST CHANGES: Some key technology tasks in support of Phase I systems scheduled for start in FY89 have been postponed until FY90. Postponed tasks of $7M have been added to planned FY90 costs.

F. (U) PROGRAM DOCUMENTATION:

o SDI Space Structures and Materials Requirements Package, AFSTC	5/86
o SDIO SCP	8/87
o SDIO PMP	8/88
o SDIO TEMP	11/88

G. (U) RELATED ACTIVITIES: The M&S Project draws upon the materials and structures technology base of the Services and Federal Agencies, and provides essential technological underpinning for all SDS system elements. Cooperative technology demonstrations are planned with: Program Element 0603220C Surveillance, Acquisition, Tracking and Kill Assessment; Program Element 0603221C, Directed Energy Weapons; and Program Element 0603222C, Kinetic Energy Weapons.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS:

o (U) SDIO/KT has established a scientific cooperative research exchange (SCORE) effort with the United Kingdom Ministry of Defense to discuss materials and structures research and development advances of benefit to SDIO requirements.

o (U) Westlands, Courtaulds, Specmat, United Kingdom, are developing advanced, ultra high modulus graphite thermoplastics for SDI systems applications. The three contracts total approximately $280K per year and were initiated in 1987.

o (U) The European Space Tribology Center has approximately $300K per year contract let in 1987 to develop ultra-low friction films for use by SDI system designers in critical moving assemblies for space applications.

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 54
Budget Activity: 02 Advanced Technology Development

J. (U) MILESTONE SCHEDULE:

o Delta Star Materials-Flight Demo	2Q FY 89
o Ground Test of Advanced Thermoplastic Truss Structure for SBI Platforms	4Q FY 89
o HTS IR Detector Key Test	1Q FY 91
o Precision Gimbal Test	1Q FY 91
o Complete Development of Integrated Structures Model	2Q FY 91
o Lightweight Composites Radiator Panel Demo	2Q FY 92

FY 1990/1991 Biennial RDT&E Descriptive Summary

Program Element: 0603224C
PE Title: Survivability, Lethality, and Key Technologies (U)

Project Number: 55
Budget Activity: 02 Advanced Technology Development (U)

A. (U) Resources ($ in Thousands)

Project Title:	FY1988 Actual	FY1989 Estimate	FY1990 Estimate	FY1991 Estimate	To Complete	Total Program
Countermeasures	21,245	22,270	34,994	42,356	Continuing	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The purpose of the SDI countermeasures project is to identify likely Soviet countermeasures to strategic defense system concepts (and/or individual system components) to assist defense systems designers to make their systems robust against potential Soviet countermeasures. The countermeasure may be technical -- directed specifically against the hardware of the defense system; tactical -- designed to avoid or suppress the defense; or political --designed to prevent full deployment of the defense system through outside means such as arms control or fostering opposition to the defense system by our allies. To identify how future defenses are likely to perform against future threats, the countermeasures project uses a Red-Blue Team methodology. This approach pits Blue forces against Red forces under oversight of Mediators in realistic future threat encounters. The Threat Analysis Program is conducted to provide a continuously updated Intelligence Community validated System Threat Analysis Report (STAR), which is the document against which system-specific, "design-to" threat specifications are developed. These analyses include the development of attack simulations and lethality models.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLAN:

1. (U) FY 1988 Accomplishments: The Strategic Red Team, established in FY 1985, continued analyzing likely Soviet political, economic, and doctrinal responses to a U.S. strategic defense. It interacted with the Technical Red/Blue Teams to determine the probable likelihood the Soviets would develop various technical counters. Technical Red/Blue Team analyses begun in FY 1986, (Spacebased Interceptor/SBI and Groundbased Midcourse Interceptor/GBMI) and FY 1987 (Innovative Architectures and Groundbased Laser/GBL) were continued. A new team was established to address the current Defense Acquisition Board (DAB) Phase 1 Architecture. The SBI, GBMI, and GBL completed significant portions of their analysis and recommendations were submitted to the SDIO Deputy Director and Chief Scientist. The experiments program concentrated on threat representative post-boost vehicle design and light replica decoys. A Far East/Pacific Theater threat assessment and an analysis of Service and DoE attack generation simulators currently being used to support effectiveness analysis of the SDS were conducted. Booster and payload models to support threat and lethality analyses were also developed.

2. (U) FY 1989 Planned Program: The Strategic Red Team will continue interacting with the technical Red/Blue teams to evaluate proposed technical countermeasures from a Soviet perspective. The current Red and Blue teams will continue in FY89. Scheduling will be established to support

Program Element: 0603224C
PE Title: Survivability, Lethality and Key Technologies (U)
Project Number: 55
Budget Activity: 02 Advanced Technology Development (U)

programmatic decision making for the specific system concepts. The experiments program will continue the core research, target technology base, and light replica decoy test efforts. Threat analysis of the SDS that include groundbased radars and interceptors will be conducted to support the update of the STAR as required by the DAB.

3. (U) FY1990 Planned Program: The Strategic Red Team will continue analyzing likely responses to a U.S. strategic defense from a Soviet political, economic, and doctrinal perspective and assist the Technical Red/Blue Teams in determining probable Soviet likelihood for developing various technical counters. Technical Red/Blue Team analyses will focus on defining likely countermeasures to the SDS Phase 1 architecture and its components, such as the boost surveillance and tracking system (BSTS), space surveillance and tracking system (SSTS), groundbased radar (GBR), spacebased interceptor (SBI), exoatmospheric reentry vehicle interceptor system (ERIS), and associated battle management, command, control and communications (BM/C^3). The experiments program will concentrate on light replica decoy concepts, designs, and rapid deployment tests; the target technology base will concentrate on defining target requirements necessary to satisfy concept validation objectives. Threat analyses that look beyond Phase I will continue in support of the STAR and threat specification update and validation process.

4. (U) FY1991 Planned Program: The Strategic Red Team will continue interacting with the technical Red/Blue Teams and evaluating proposed technical and non-technical countermeasures from a Soviet perspective. All technical Red and Blue teams functioning at the end of FY 1990 will continue in FY 1991. New teams will be started to address current countermeasure issues associated with the SDS Phase 1 architecture. The experiments program will continue the core research, target technology base, and light replica decoy test efforts. Threat analyses will continue to incorporate additional booster, payloads, ASATs, and directed energy weapons as they are identified as part of the STAR and threat specification updateand validation process.

5. (U) Program to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY:

- System Planning Corporation, Arlington, Virginia (prime contractor)
- Massachusetts Institute for Technology/Lincoln Laboratory, Lexington, Massachusetts
- Sandia National Laboratories, Albuquerque, New Mexico
- Ballistic Missile Organization, Norton AFB, San Bernadino, California
- Foreign Technology Division, Wright-Patterson AFB, Dayton, Ohio
- Army Strategic Defense Command, Huntsville, Alabama

Program Element: 0603224C
PE Title: Survivability, Lethality, and Key Technologies (U)

Project Number: 55
Budget Activity: 02 Advanced Technology Development (U)

E. (U) COMPARISON WITH FY1989 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	Reduced	Delayed 1 yr	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

(U) NARRATIVE DESCRIPTION OF CHANGES

1. (U) TECHNICAL CHANGES: The FY 1989 Descriptive Summary planned for robust countermeasures and threat projects to validate likely countermeasures with appropriate development and testing. FY89 budget constraints reduced the countermeasures project from a planned $28.62M to $22.345M. The FY89 countermeasures project will maintain a basic core program, but provide significantly reduced funds for testing and no funds for threat definition efforts. The FY 1990 estimate of $35.04M and the FY 1991 estimate of $42.42M are requested to reestablish a robust countermeasures project.

2. (U) SCHEDULE CHANGES: The constrained countermeasures and threat project budget for FY89 has delayed needed system countermeasure testing and threat analysis. This will result in detailed countermeasure data and threat analyses not being available to system designers. It is estimated that a one year slip will occur in the availability of the detailed information.

3. (U) COST CHANGES: See discussion above.

F. (U) PROGRAM DOCUMENTATION: Statement of Work 6/86

G. (U) RELATED ACTIVITIES: The countermeasure and threat projects involves organizations of the Army, Navy, Air Force, and Department of Energy (DOE). Activities are defined in Work Package Directives for the Services and Statements of Work for Federally Funded Research and Development Centers, DOE, and the prime contractor. Coordination is accomplished through daily monitoring of activities and a weekly technical interchange and direction meeting with prime contractor management. Periodic meetings with representatives from the Services, Agencies, and the Department of Defense ensure there is no unnecessary duplication .

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

Program Element: 0603224C
PE Title: Survivability, Lethality, and Key Technologies (U)

Project Number: 55
Budget Activity: 02 Advanced Technology Development (U)

J. (U) MILESTONE SCHEDULE:

Established SDIO Countermeasures Program	4QFY1985
Established Strategic Red Team and Technical Red Teams	4QFY1985
Let Prime Contract	3QFY1986
Established Experiments Program	3QFY1987
Exercised Prime Contract Option I	3QFY1987
Exercise Prime Contract Option II	3QFY1988
Flight Test Countermeasures	3QFY1989
Exercise Prime Contract Option III	3QFY1989
Exercise Prime Contract Option IV	3QFY1990
STAR update	Annually

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C
PE Title: Survivability, Lethality, and Key Technologies (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)

Popular Name	FY88 Actual	FY89 Estimate	FY90 Estimate	FY91 Estimate	To Complete	Total Program
Innovative Science and Technology	23,600	18,400	40,920	48,630	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Explores innovative technologies for survivability and lethality. Seeks revolutionary breakthroughs in all technologies that would make a leap in capability for SDI survivability and lethality. The funding totals also include all SDI SBIR awards, which make about a third of FY 89 totals.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments: IST research advanced many innovations for consideration by SDI system designers. For example:

o (U) Launched a test rocket outside the atmosphere Space Experiment Aboard Rockets (SPEAR) that verified predictions that much less insulation was needed to isolate high voltage components in space.

o (U) Developed the largest third order optical shutter material with organic material. Developed fluoroethanol as an alternative to liquid crystals for fast non-linear optics.

o (U) Found the largest third order broadband optical susceptibility ever reported.

(U) FY1989 Planned Program: IST efforts will continue to explore the cutting edge of SA/BM technologies.

(U) FY1990/1991 Planned Programs: Continue exploratory innovations. Specific projects cannot be predicted.

(U) SBIR Accomplishment and Plans: No SBIR Phase 2 has yet been completed. SDI has selected 10 Phase 2 winners in Survivability and Lethality technologies. About half have started the Phase 2 work. In FY88 it also selected 10 new Phase 1 winners. The first Phase 2 completions will happen in FY89. SBIR awards will be made in accordance with PL97-219 to the best proposals offered across all the technical topics solicited by SDI.

D. (U) WORK PERFORMED BY: Various institutions (universities, private firms, national laboratories, federally funded research centers) under contract to Defense Nuclear Agency and other agencies.

Program Element: 0603224C
PE Title: Survivability, Lethality, and Key Technologies (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

E. (U) COMPARISON WITH FY88 DESCRIPTIVE SUMMARY: Technical accomplishments are all first-ever events.

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION:

G. (U) RELATED ACTIVITIES: IST contributes technology advances to all SDI elements and to military and civil applications. Many of technical advances will have wide impact on military and civil technology.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Not Applicable. Research is the forefront of technology where events cannot be predicted.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603224 Project Number: 83
PE Title: Survivability, Lethality, & Key Technologies Budget Activity: 02

A. (U) RESOURCES ($ in Thousands)
Project Title: Support Programs

Popular Name:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Support Programs	23,111	15,248	8,472	8,578	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides funding for Army and Air Force program management expenses for civilian personnel, travel (TDY), training, rents, communications, information management, utilities, printing and reproduction, supplies, equipment, and contracts for research and support services.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS: The funding provided to the services by this project enables them to centralize recurring operating costs so that funding for technical research may be devoted solely toward that purpose.

D. (U) WORK PERFORMED BY: Primarily the civilian employees of the Army Strategic Defense Command (Huntsville AL and Crystal City VA) and the Air Force Space Division (Los Angeles). Civilian personnel costs comprise 60% of the support programs' funding provided to the services. Work is also performed by the following major contractors:

Integration Support, Ford Aerospace Division, Los Angeles (AF)
Systems Engineering Support, ANSER Inc., Los Angeles, (AF)
C&M for Simulation Center, COLSA Inc., Huntsville (Army)
Systems Engineering Support, GRC Inc., Huntsville (Army)
MIS Software Maint & Opns, Hewlett Packard, Hunstville (Army)

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY: Support programs have not been separately identified in previous submissions. The decrease in funding levels from FY88/FY89 to FY90/91 are due to the completion of the HELSTF project (RDT&E-funded contruction) which was carried in this program element under Project 83.

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: N/A
2. SCHEDULE CHANGES: N/A
3. COST CHANGES: N/A

Program Element: #0603224 Project Number: 83
PE Title: Survivability, Lethality, & Key Technologies Budget Activity: 02

F. (U) PROGRAM DOCUMENTATION: Services submit detailed justification using SDIO Work Package Directive format to document each year's support program requirements.

G. (U) RELATED ACTIVITIES: Support programs funding for the Army and Air Force are also found in each of the other four SDIO program elements under Project 83.

H. (U) OTHER APPROPRIATION FUNDS: None

1. PROCUREMENT (Specify Appropriation): None

2. MILITARY CONSTRUCTION: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

FY 1990/1991 BIENNAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0604220C
PE Title: Phase I Strategic Defense System (U)

Project: 60
Budget Activity: 02 Advanced Technology Development (U)

Project Title: Boost Surveillance & Tracking System (BSTS) (U)

PICTURE/SCHEMATIC ON NEXT PAGE

POPULAR NAME: BSTS (U)

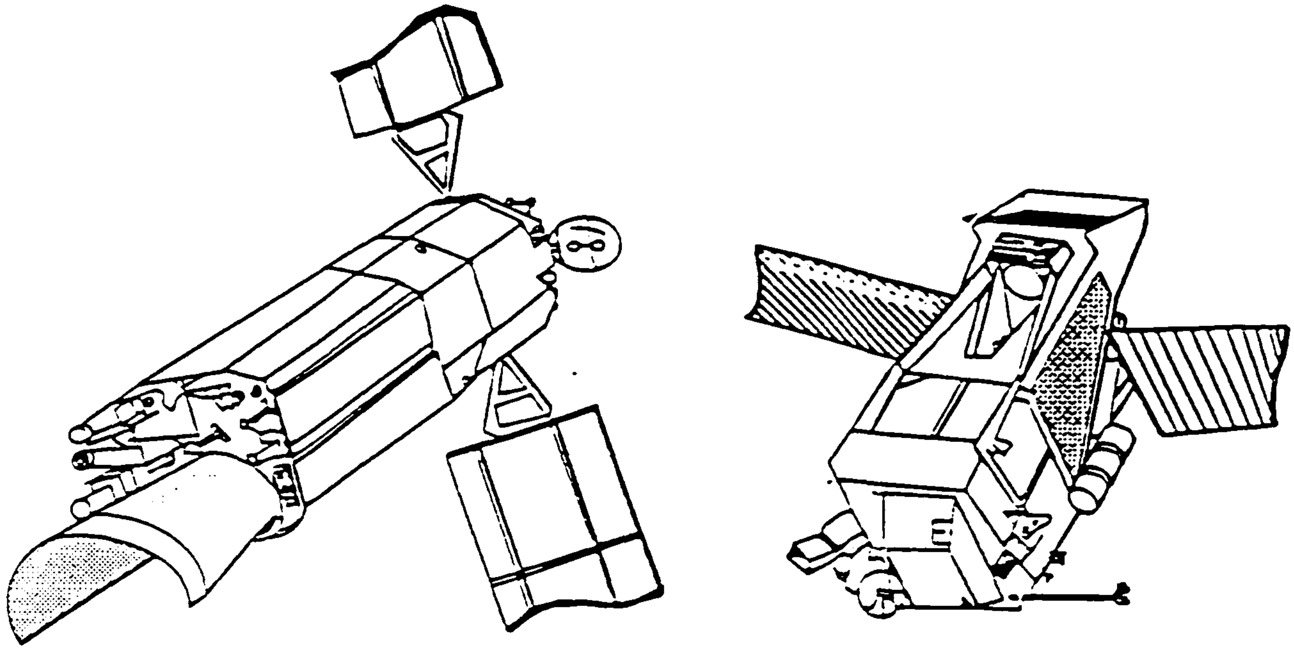
A. (U) SCHEDULE/BUDGET INFORMATION: ($ in thousands)

SCHEDULE(U)	FY 88	FY 89	FY 90	FY 91	To Complete
(X)Program Milestones			Milestone II	Preliminary Design Review	XXXXXX XXXXXX XXXXX
Engineering Milestones (U)			End-to-End Ground Demo FY90-FY92		System Design & Fabrication for Launch
(X) T&E Milestones					XXXXXXX XXXXXXXXXX XXXXX
(U)Contract Milestones			Authority to Proceed		Continuing
(U)BUDGET	FY 88	FY 89	FY 90	FY 91	Prog Total To Complete
(U)Major Contract			262,000	427,000	Continuing
(U)Support Contract					
(U)In-House Contract					
(U)GFE/ Other					
Total			262,000	427,000	Continuing

Program Element: 0604220C
PE Title: Phase I Strategic Defense System (U)

Project: 60
Budget Activity: 02 Advanced Technology Development (U)

SCHEMATIC: TWO COMPETING BSTS CONCEPTS (U)



B. (U) <u>BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES</u>

(X) This project will accomplish the Full Scale Development necessary for a fully responsive advanced space-based system to detect and track ballistic missiles in their boost [redacted]. This data will be used to generate initial tactical warning/attack assessment (TW/AA) and follow-on attack status reports, which are communicated to the National Command Authorities (NCA), to subsequent layers of surveillance systems, and, potentially, to defensive weapon systems. Since this system will potentially provide the first warning and attack assessment to the NCA, as well as handover to other SDS elements, it must be highly survivable through all levels of conflict. [redacted] Specifically, improvements are expected in on-board signal and data processing, protection against direct and indirect attacks, and in [redacted]. All activities for this program in FY1990 and FY1991 have been reviewed and determined to be in compliance with the ABM Treaty.

Program Element: 0604220C
PE Title: Phase I Strategic Defense System (U)

Project: 60
Budget Activity: 02 Advanced Technology Development (U)

(U) The Demonstration/Validation lead-in to this project was contained in Project 8, Boost Dem/Val, PE0603220C.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY1988 Program Accomplishments:
See Project 8, PE0603220C for BSTS activities prior to Milestone II.

2. (U) FY1989 Planned Program:
See Project 8, PE0603220C for BSTS activities prior to Milestone II.

3. (U) FY1990 Planned Program:

(U) The BSTS will continue to undergo extensive, end-to-end, ground testing on components/subsystems.

(U) Specific system analysis, design, fabrication data, and schedule information is available at a higher classification level.

(U) Long lead items for the flight experiment and FSD vehicles (e.g., optical mirror blanks) will be procured.

4. (U) FY1991 Planned Program: (U) Efforts will focus on completing a Preliminary Design Review.

D. (U) WORK PERFORMED BY: This program is managed for the SDIO by the Air Force Space Division, El Segundo, CA. A single contractor will be selected in FY1990 following the Project 8, Boost Dem/Val Final Design Review.

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY:

IMPACT OF CHANGES (U)

CHANGE	SYSTEM CAPABILITIES	SCHEDULE	FY1990 COST
(U) Eng			
(U) Sched			
(U) Cost			$262M increase

NARRATIVE DESCRIPTION OF CHANGES (U)

1. ENGINEERING CHANGES: (U)
2. SCHEDULE CHANGES: (U)
3. COST CHANGES: (U) Project created by transfer of funds ($262M) from Project 8, Program Element 0603220C.

F. (U) PROGRAM DOCUMENTATION:
(U) BSTS Technical Requirements Document - February 1985
(U) BSTS System Specification - August 1986
(U) BSTS System Requirements Document - August 1986
(U) BSTS Dem/Val Environmental Assessment - August 1987
(U) System Concept Paper (BSTS Appendix) - August 1987
(U) VUE Subsystem Specification - August 1987

G. (U) RELATED ACTIVITIES: Program Element 0603220C, Surveillance, Acquisition, Tracking, and Kill Assessment (Project 8).

H. (U) OTHER APPROPRIATION FUNDS: Military Construction: $25.179M in FY1991 for fixed ground station.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: N/A

J. (U) TEST AND EVALUATION DATA: N/A

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0605398C
PE Title: Management Headquarters (U)

Budget Activity: 06 Defense-Wide Mission Support

A. (U) RESOURCES: ($ in Thousands)

Project Number & Title	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
01 Headquarters Support	20,026	21,000	26,394	27,456	Continuing	

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element provides the resources for the Director and the staff to execute their responsibilities as OSD's primary agent for managing the strategic defense research and development program. Funding is used primarily to cover routine expenses associated with day-to-day operations and to provide the administrative support services necessary for effective internal management and operation of the Strategic Defense Initiative Organization (SDIO). Routine operating expenses include:

- o civilian salaries and benefits,
- o travel and transportation for both the civilian and military SDIO staff,
- o communications,
- o rents and utilities,
- o support service contracts, and
- o supplies and equipment.

Support services include:

- o resource management (fiscal management, human resource management, and internal management controls),
- o external liaison with Congress, private industry, the scientific community, and the media,
- o multinational program oversight,
- o internal security and technical security analysis,
- o contract administration including the small/disadvantaged business program, and
- o information management including automation.

Program Element: 0605398C
PE Title: Management Headquarters (U)

Budget Activity: 06 Defense-Wide Mission Support

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

FY 1988 Accomplishments: (U) The Management Headquarters (MHQ) Account provided funding those recurring support programs and operating expenses necessary for the efficient and effective management of the Strategic Defense Program by the SDIO.

FY 1989 Planned Program: (U) The MHQ Account will continue to fund the same types of support programs and expenses; however, below threshhold reprogramming may be required to meet increased Management Information Support (MIS) services as well as increases in communications, rents, utilities, and office equipment.

FY 1990/1991 Planned Program: (U) The increase in funding sought for FY1990 and FY1991 results from a proportionate growth in the other SDIO program elements as the Strategic Defense System begins transition of initial elements to full scale development.

c (U) To meet the resultant expansion in SDIO's management and oversight requirements, DoD has recognized the longstanding shortfall in SDIO manpower. Accordingly, this budget includes funding to cover an anticipated increase in SDIO civilian personnel strength over the next two years. A portion of this increase is also desired in an effort to rely less heavily on Contract Advisory and Assistance Services (CAAS).

c (U) Likewise, significant increases in automation and information management costs are expected in order to meet the absolute requirement for programmatic and financial accountability. In this regard, the SDIO Management Information System (MIS) has nearly completed the documentation and design phase and will begin full implementation of a network compatible with the Services and Agents who execute the Strategic Defense Program. This will enable SDIO to assume a more central role in the planning, execution, and management of information resource activities throughout the Strategic Defense Program.

c (U) The Headquarters Management program element amounts to less than half of one percent of SDIO's FY 1990 budget request. Without an increase over the next two fiscal years, continued effective stewardship of the Strategic Defense Program program will become increasingly difficult.

D. (U) WORK PERFORMED BY: Primarily the military and civilian personnel of SDIO. (Civilian personnel costs comprise the largest single expense in the Management Headquarters Account.) Work is also performed by the following contractors:

Polaris, Inc.,	Internal Security and Information Management
Brogan Assoc., Inc.	Technical Security Analysis
Institute for Defense Analysis	Technical Library
B-K Dynamics, Inc.	Multinational Agreements
RJO Enterprises	Acquisition Management

Program Element: 0605398C
PE Title: Management Headquarters (U)

Budget Activity: 06 Defense-Wide Mission Support

E. (U) COMPARISON WITH FY1988 DESCRIPTIVE SUMMARY: No substative changes.

F. (U) PROGRAM DOCUMENTATION: The SDIO headquarters management funding is accomplished IAW DoD Directive 5100.73 and SDIO Administrative Instruction 7201. A formally appointed management board chaired by the SDIO Deputy Director reviews the Management Headquarters Account budget and expenditures.

G. (U) RELATED ACTIVITIES: This program element supports the other six technical program elements of the Strategic Defense Research and Development program.

H. (U) OTHER APPROPRIATION FUNDS: None.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None.

J. (U) MILESTONE SCHEDULE: Not applicable.

MAJOR IMPROVEMENTS TO AND CONSTRUCTION OF GOVERNMENT OWNED FACILITIES FUNDED BY RDT&E

Department/Agency: Strategic Defense Initiative Organization (SDIO)

PART I. UTILIZATION OF SECTION 2353, TITLE 10 AUTHORITY

Facility/Equipment	RDT&E P.E. Number	Contractor	Location	Total Obligational Authority (Thousands of Dollars) 1988	1989	1990	1991
SECTION I							
Projects accomplished or Underway							
Neutral Particle Beam (NPB) Ground Test Accelerator Facility 1/	6221	Los Alamos National Lab	Los Alamos, New Mexico	6,000	3,000	- 0 -	- 0 -
Narrative Statement: Provides permanent buildings, utilities and site preparation for Ground Test Accelerator (includes heating and cooling equipment to be housed in an adjacent building).							
NPB Technical Support Facility 1/	6221	Los Alamos National Lab	Los Alamos, New Mexico	5,100	- 0 -	- 0 -	- 0 -
Narrative Statement: Provides secure laboratory and office space adjacent to NPB facility.							
Strategic Defense Facility 1/	6221	Sandia National Lab	Sandia, New Mexico	10,000	3,700	- 0 -	- 0 -
Narrative Statement: Provides a research and testing laboratory for Strategic Defense Initiative programs.							

1/ Previously listed in RDT&E Congressional RD-4 Exhibit for FY 1989
2/ Initial Listing

Facility/Equipment	RDT&E P.E. Number	Contractor	Location	Total Obligational Authority 1988	1989	1990	1991
Lethality Test Systems 1/	6222	Los Alamos National Lab	Los Alamos, New Mexico	1,500	- 0 -	- 0 -	- 0 -

Narrative Statement: The research project to be supported by this facility was terminated in October 1987 in favor of Thunderbolt-SUVAC II. Prior Year funding is for termination costs.

Rep-Pulsed Chemical Laser (RPCL) Equipment Installation 1/	6224	TRW	Capistrano, California	300	- 0 -	- 0 -	- 0 -

Narrative Statement: Provides for design and installation of equipment to increase the laser run-time from a capability of 50 pulses in one second to 250 pulses in five seconds.

Glass Laser Equipment Installation 1/	6224	Battelle Memorial Institute	Columbus, Ohio	400	- 0 -	- 0 -	- 0 -

Narrative Statement: Provides for design, development, and installation of equipment to deliver waveforms similar to a free-electron laser.

Thunderbolt SUVAC II Electromagnetic Launcher 1/	6224	Westinghouse Electric Corporation	Sunnyvale, California	13,100	5,500	- 0 -	- 0 -

Narrative Statement: Provides for design, development, and installation of Thunderbolt Electromagnetic Launcher as a kinetic energy test bed capable of firing a large projectile at very high velocity.

1/ Previously listed in RDT&E Congressional RD-4 Exhibit for FY 1989
2/ Initial Listing

Facility/Equipment	RDT&E P.E. Number	Contractor	Location	Total Obligational Authority (Thousands of Dollars) 1988	1989	1990	1991
Electric Gun System 1/	6224	Lawrence Livermore Laboratories	Livermore, California	200	800	- 0 -	- 0 -

Narrative Statement: Provides for design, development, and installation of a modification to the Electric Gun System to allow the launch of large, hypervelocity foil to perform lethality testing.

SECTION II

Projects Planned or Projected

None

PART 2. UTILIZATION OF RDT&E APPROPRIATION FOR FACILITIES AT GOVERNMENT-OWNED/GOVERNMENT-OPERATED INSTALLATIONS

Facility/Equipment	RDT&E P.E. Number	Location	Total Obligational Authority (Thousands of Dollars) 1988	1989	1990	1991

SECTION I

Projects Accomplished or Underway

Ground-Based Free Electron Laser Facility 1/	6221	White Sands Missile Range, New Mexico	12,600	19,000	32,000	40,000

Narrative Statement: Provides technical facilities for Free Electron Laser (FEL) Accelerator and Wiggler and Beam Director and Optical Bench (Beam Control System); and, support facilities, including office space and facilities for assembly and characterization and repair of optics and electronics.

1/ Previously listed in RDT&E Congressional RD-4 Exhibit for FY 1989
2/ Initial Listing

Facility/Equipment	RDT&E P.E. Number	Location	Total Obligational Authority (Thousands of Dollars) 1988	1989	1990	1991
Temporary Consolidated Operations Center (CSOC) Modifications 2/	6223	Falcon AFB, Colorado	1,140	- 0 -	- 0 -	- 0 -
Narrative Statement: Provides temporary modifications to the CSOC, Falcon Air Force Base, Colorado, to meet interim requirements for the SDI National Test Bed.						
Airborne Optical Adjunct (AOA) Facility Rehabilitation, Power Supply, and LN Plant 2/	6220	Kwajalein Atoll	370	- 0 -	- 0 -	- 0 -
Rocket/Payload Processing Facilities 2/		Barking Sands, Hawaii	208	- 0 -	- 0 -	- 0 -
Lawndale Missile Plant Perimeter Fence and Entry Control Building 2/	6220	Los Angeles, California	201	- 0 -	- 0 -	- 0 -
Radiation Effects Facility Modification 1/	6222	Griffiss AFB, New York	250	- 0 -	- 0 -	- 0 -
STARBIRD Launch Complex 1/	6221	Cape Canaveral, Florida	- 0 -	1,800	- 0 -	- 0 -
Narrative Statement: Provides for the construction of two identical launch pads and launch equipment buildings. Project also will renovate two existing facilities to be used as a payload assembly building and a launch control center.						

1/ Previously listed in RDT&E Congressional RD-4 Exhibit for FY 1989
2/ Initial Listing

Facility/Equipment	RDT&E P.E. Number	Location	Total Obligational Authority (Thousands of Dollars) 1988	1989	1990	1991
STARBIRD Launch Complex 1/	6221	Wake Island	- 0 -	8,000	- 0 -	- 0 -

Narrative Statement: Provides for the construction of two identical launch pads. Project will renovate existing facilities to be used as payload assembly, launch control, missile assembly and housing. Two instrumentation sites will also be developed.

Power Plant Reactivation 2/	6222	Meck Island, Kwajalein Atoll	1,650	- 0 -	- 0 -	- 0 -

Narrative Statement: Install five replacement 575 KW diesel engine driven generators and automatic control systems to provide adequate power to support the ERIS and HEDI projects.

SECTION II

Projects Planned or Projected

None

PART 3. UTILIZATION OF RDT&E APPROPRIATION FOR MINOR CONSTRUCTION

SUMMARY OF MINOR CONSTRUCTION FUNDED BY RDT&E, SDIO (Thousands of Dollars)

FY 1988	FY 1989	FY 1990	FY 1991
1,929	2,000	2,000	2,000

1/ Previously listed in RDT&E Congressional RD-4 Exhibit for FY 1989
2/ Initial Listing

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project: 43
Budget Activity: 02 Advanced Technology Development (U)

- (U) A real time distributed operating system will be transitioned to support experimental system evaluations.

- (U) Laser communications subsystem prototype development will continue.

5. (U) Program to Completion: This is a continuing project.

D. (U) WORK PERFORMED BY: This work is so broad that it spreads across a wide community of both contractors and federal agencies. For example:

- (U) TRW has developed, and is continuing, break-through work on algorithms to handle difficult tasks in surveillance-tracking-interceptor assignment.

- (U) Alphatech Incorporated (a small firm in Burlington, MA) has created superior algorithms, and accompanying analysis techniques, based on nonlinear network flow optimization; this basic work is intended to help battle manager computers to select correctly from alternative tactical choices.

- (U) Rome Air Development Center (USAF) is performing exceptionally valuable work in packet-switching communications, particularly to/from/among multiple satellites in space.

- (U) Other contractors include SPARTA, Martin Marietta, and Texas Instruments.

- (U) NASA, NSA, and DARPA also provide significant support.

E. (U) COMPARISON WITH FY1989 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	Tech Projects Down-scoped	N/A	N/A
Schd	N/A	Communications Projects Deferred	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: Planned new projects in communications and software engineering were not executed due to FY89 funding cuts.

2. (U) SCHEDULE CHANGES: Technology projects revised to accommodate overall SDI schedule adjustment in response to budget changes.

3. (U) COST CHANGES: NONE

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project: 43
Budget Activity: 02 Advanced Technology Development (U)

F. (U) PROGRAM DOCUMENTATION:

System Concept Paper	4/88
Test and Evaluation Master Plan	6/87
SDI Program Master Plan	4/88

G. (U) RELATED ACTIVITIES: Program Element #63223C, System Analysis and Battle Management (BM/C3 Experimental Systems, National Test Bed, and SDS Phase I Engineering)

H. (U) OTHER APPROPRIATION FUNDS: NONE

I. (U) INTERNATIONAL COOPERATIVE EFFORTS: NONE

J. (U) MILESTONE SCHEDULE:

Second Generation Algorithms	FY89
Mosaic Processor Demo	FY89
Prototype Processor	FY91
Multiple Beam Antenna (Comm)	FY89
Agile Beam Control (Comm)	FY90
Phased Arrays (Comm)	FY91
Software Center	FY90
Complete prototype SDS	FY91

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management
Project Title: BM/C3 Experimental Systems (U)

Project Number: 44
Budget Activity: 02 Advanced Technology Development (U)

PICTURE/SCHEMATIC ON NEXT PAGE

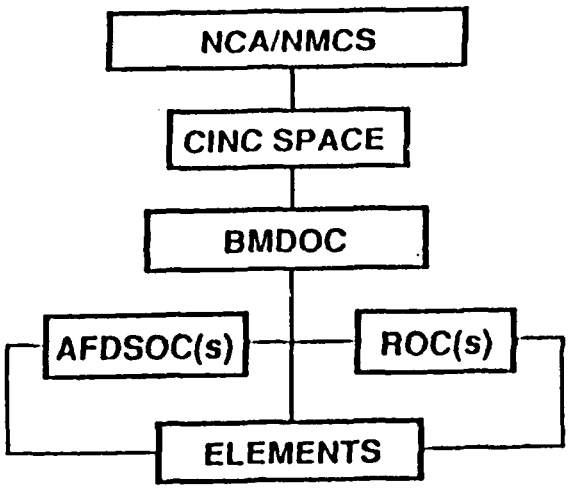
POPULAR NAME: Command Center/ System Operation and Integration Functions (CC/SOIF) Experimental Systems (U)

A. (U) SCHEDULE/BUDGET INFORMATION: ($ in thousands)

SCHEDULE	FY 88	FY 89	FY 90	FY 91	To Complete
(U)Program Milestones		Pilot CC Build 1	Pilot CC Build 2	Pilot CC Build 3	II, 93-94
Engineering Milestones (U)		Interim Requirements Review	System Requirements Review	B1 Specifications for CC	
(U) T&E Milestones			CC Build 1 and 2 Experiments	CC Build 3 Experiments	DTI, 90-92
Milestones Contract (U)	GBEV(EV0-EV1)	GBEV(EV2-EV5)	GBEV(EV6-EV7)		
(U)BUDGET	FY 88	FY 89	FY 90	FY 91	Prog Total
(U)Major Contract	82,973	68,179	133,778	183,071	Continuing
(U)Support Contract	8,100	6,000	10,000	20,000	Continuing
(U)In-House Contract					Continuing
(U) GFE/ Other					Continuing
(U)Total	91,073	74,179	143,778	203,071	Continuing

CC ELEMENT

Command Hierarchy



BMDOC

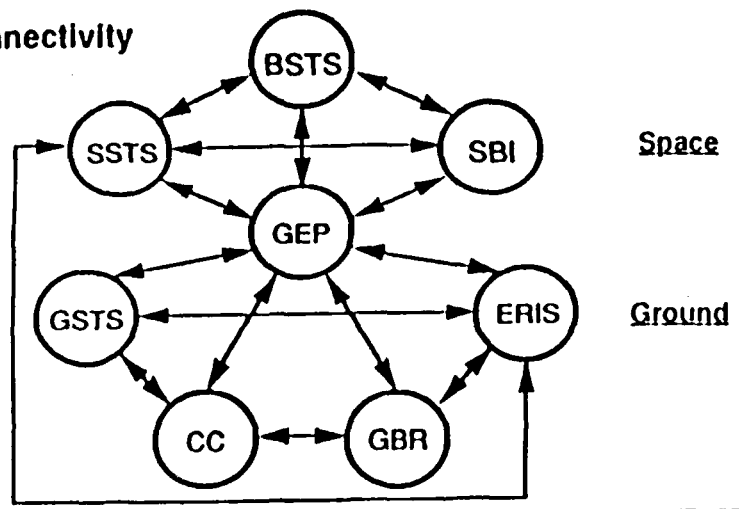
Functions

- Maintain Human Control
- Assess Situation
- Select/Implement Mode & Battle Plan
- Coordinate With Forces & Higher Authority
- Evaluate Engagements
- Reconfigure/Reconstitute
- Conduct Operational Exercises
- Develop Battle Plans

Messages

- Receive Sensor Message
- Command Mode & Battle Plan
- Transmit/Receive Health And Status
- Command Weapons Release/Termination

Connectivity



AFDSOC/ROC

Functions

- Establish and Maintain Readiness
- Manage Deployment/Updates
- Perform Planning, Intelligence Gathering, Security, And Communications
- Alternate CC

Messages

- Tracking, Telemetry And Control
- System/Element Status
- Receive/Acknowledge BMDOC Direction

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)
Project Number: 44
Budget Activity: 02 Advanced Technology Development (U)

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:
This project has two major tasks.

(U) Task 1 - CC/SOIF Architecture Definition: Includes analysis, research and development, and design of Command and Control, Systems Operation and Integration Functions (CC/SOIF) for a strategic defense. The task establishes the quantitative subsystem functional requirements, and includes technology tradeoffs and development of experimental CC/SOIF operational concepts and specifications. This work is undertaken in close coordination with system engineering activities (Project 46). This task also establishes requirements for the CC/SOIF Experimental Program and for the CC/SOIF Technology Development Project. In addition to CC/SOIF operational concepts and system functionality, this task addresses techniques to achieve and demonstrate the system security, system robustness and survivability, system tests, and system evolution which will be required of the SDS Command and Control element.

(U) Task 2 - CC/SOIF Experimental Systems Project: This project supports the Dem/Val phase and is central to the resolution of technical issues prior to entry into FSD. The project consists of experimental activities which provide the environments and test articles necessary to demonstrate and validate Phase I CC/SOIF concepts and designs for the Command Center element and its related command and control functions. At the subsystem level the project consists of the following major CC/SOIF experimental activities: 1) Tracking and Discrimination experiments, 2) Weapons and Sensor Control experiments, 3) Distributed Multinode Network experiments, and 4) Pilot and Prototype Command Center experiments.

(U) The Experimental Systems project also integrates the prototype CC/SOIF subsystems to provide simulations and emulations of increasing complexity and fidelity. Integrated system experiments will replicate the integration of hardware/software/man-in-the-loop in a CC/SOIF system driven by threat scenarios. The U.S. Army EV-88 experiment employs high fidelity models of sensors, weapons, and environments and is currently providing an evaluation of the Phase I architecture with respect to CC/SOIF during the Midcourse and Terminal phases of ballistic missile defense. A SDS Development Laboratory will be established to permit advanced experiments capable of simulating all phases of strategic defense.

(U) Real-world data collection will provide empirical data that enhances the fidelity achievable through simulation. This activity is important as a major source of real-world data collection, and will be expanded to include data available from related SDIO eperiments.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY88 Accomplishments:

- (U) A baseline CC/SOIF architecture has been identified.
- (U) Initial requirements for the Experimental Systems program have been identified.

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)

Project Number: 44
Budget Activity: 2 Advanced Technology Development (U)

- (U) The EV-88 near-term experiments (Levels 0 & 1) were successfully completed.

- (U) A software policy was adopted based upon the recommendations of the Defense Science Board (DSB).

- (U) Development of a set of human command and control engagement decision criteria applicable to Boost phase of defense.

- (U) A Decision Aid Test Environment (DATE) was prototyped to measure human responses.

- (U) A processor-to-processor electronic interface between the National Test Facility and the EV-88 simulation site was established.

2. (U) FY1989 Planned Program:

- (U) Refinement of content and scope of experimental activities.

- (U) Establishment of SDS Development Laboratory for conduct of advanced CC/SOIF simulations.

- (U) Development of the PILOT Command Center experiment.

- (U) Incorporation of empirical data from element flight tests to support simulations.

3. (U) FY1990 Planned Program:

- (U) Initiate design effort for prototype space-ground communications facility.

- (U) Investigate and analyze survivable fiber-optic network and network switch requirements and develop an experiment plan.

- (U) Initiate tracking algorithm, battle planning/sensor planning algorithms, and distributed multi-node network experimental test beds.

4. (U) FY1991 Planned Program:

- (U) Initiate acquisition of prototype space-ground communications facility.

- (U) Conduct survivable fiber-optic network and network switch experiments.

- (U) Continue to increase fidelity of tracking algorithm, battle planning/sensor planning, and distributed multi-node network experiment test beds.

Program Element: 0603223C
PE Title: Systems Analysis & Battle Management (U)
Project Number: 44
Budget Activity: 02 Advanced Technology Development (U)

5. (U) Program Plan to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: The major implementation and integration contract for the CC/SOIF Experimental Program is held by TRW, Incorporated; its work is centered at Huntsville, Alabama, under the Army's Strategic Defense Command.

E. (U) COMPARISON WITH FY1989 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	Consolidation of Activities	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	Defer Space-based EV	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: The Experimental systems program has been consolidated into four major activities to better address all CC/SOIF critical issues.
2. (U) SCHEDULE CHANGES: Due to funding limitations in FY1988 and FY1989, the Space-based EV will not be implemented
3. (U) COST CHANGES: FY1988: -$1.5M; FY1989: -$39.9M

F. (U) PROGRAM DOCUMENTATION

(U)	System Concept Paper	4/88
(U)	Test and Evaluation Master Plan	6/87
(U)	SDI Program Master Plan	4/88
(U)	Technical Requirements Document	4/88
(U)	SDS Description Document	10/88

G. (U) RELATED ACTIVITIES: CC/SOIF Experiments will be tested in the NTB, Project 45, Systems Analysis & Battle Management, Program Element #0603223C. CC/SOIF Technology, Project 43, Program Element #0603223C provides technologies for the experimental projects. SDS Phase I Engineering, Project 46, Program Element #0603223C uses the results of experimental design, integration and test activities to refine the Phase I system design and assesses overall SDS Phase I needs to ensure that no unnecessary duplication of effort exists.

H. (U) OTHER APPROPRIATION FUNDS

1. (U) PROCUREMENT (Specify Appropriation): Not applicable.

2. (U) MILITARY CONSTRUCTION: Not applicable.

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) TEST AND EVALUATION DATA: Valuable data was collected during the GBEV Level-0 and Level-1 tests and is currently being analyzed. Additional experiments of increasing fidelity are scheduled in FY1989.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Analysis/Battle Management (U)
Project Number: 45
Budget Activity: Advanced Technology Development (02)

A. (U) RESOURCES ($ in Thousands)
Project Title: National Test Bed (U)

Popular Name	FY 1988 Actual	FY 1989 Estimate	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
National Test Bed (U)	77,713	100,179	115,827	121,802	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: The mission of the Strategic Defense Initiative (SDI) National Test Bed (NTB) Program is to support the development and deployment decision process. The purpose of the NTB is to provide a comprehensive capability to compare, evaluate, and test alternative architectures for a strategic defense against ballistic missiles, including their Battle Management/Command, Control, Communications (BM/C^3) features as well as to evaluate various defensive technologies in a system framework defined by these architectures. The definition and acquisition of this capability has been centralized in order to ensure that a single integrated capability dedicated to the SDI is available to the entire SDI community for addressing the many critical issues necessary to support informed decisions on the future development and deployment of a strategic defense. The National Test Facility (NTF) at Falcon Air Force Base, Colorado is the hub and central facility of the NTB system.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

o (U) The NTB Joint Program Office was relocated to Falcon AFB, Colorado from Hanscom AFB, Massachusetts.

o (U) Martin Marietta Information and Communications Systems of Denver, Colorado was awarded the NTB integration (Phase III) contract.

o (U) Kaiser Engineers, Inc. of Oakland, California was awarded the contract for construction of the NTF and construction of the new facility began.

o (U) Facility modifications to the Consolidated Space Operations Center (CSOC) at Falcon Air Force Base were undertaken to accommodate NTF computer and communications equipment pending completion of the permanent NTF facility.

o (U) The first two milestones of NTB development (Early Analysis Capability and Early Operational Capability) were achieved.

o (U) A videoteleconferencing network which interconnects six geographically separate facilities of the Army, Navy, Air Force, and National Laboratories into a distributed network became operational.

Program Element: 0603228C
PE Title: Systems Analysis/Battle Management (U)

Project Number: 45
Budget Activity: Advanced Technology Development (02)

2. (U) FY 1989 Planned Program:

o (U) Continue construction of the NTF; continue development and implementation of the NTB concept.

o (U) Install simulation framework on NTF Cray 2 computer; develop and promulgate simulation interface standards.

o (U) Cray, EAC, EOC, mini-gaming classified link operational.

o (U) All classified equipment and networks accredited.

3. (U) FY 1990 Planned Program:

o (U) Complete construction and transition to final National Test Facility.

o (U) Implement and integrate the NTB, the NTF, and the associated communications networks and interoperability standards to support integrated simulations/experiments at diverse geographic locations.

o (U) Add Special Access Facility to Core Support Capability, with its attendant processors (IBM-3090 and VAX 8700 cluster) and stand alone LAN to provide restricted access security environment.

o (U) Install IBM-3090 to NTB Computing Center to achieve necessary reliability/availability requirements.

o (U) Complete DETEC enhancement.

o (U) Implement SATCOM link.

4. (U) FY 1991 Planned Program:

o (U) Continue to evolve the capability of the NTB and the NTF to conduct simulations and experiments in support of strategic defense system architecture and concept evaluation activities.

o (U) Be the focal point for system-level and element-level simulations, CC/SOIF test support, data reduction and analysis, scene and object data generation, and integrated equipment control.

o (U) Phase in Advanced Simulation Framework to support conduct of high fidelity end-to-end digital simulations with multiple level fidelities and interfaces to external strategic forces.

5. (U) Program to Completion: This is a continuing program.

Program Element: 0603223C
PE Title: Systems Analysis/Battle Management (U)
Project Number: 45
Budget Activity: Advanced Technology Development (02)

D. (U) WORK PERFORMED BY: The prime contractor responsible for NTB integration is Martin Marietta. The work is being performed in temporary facilities at Falcon AFB, Colorado, and will move to the permanent NTF when construction is complete. The organization responsible for the development of the program (National Test Bed Joint Program Office) also resides at Falcon AFB. The NTB/NTF program is a contractor-operated, government-owned effort.

E. (U) COMPARISON WITH FY 1989 DESCRIPTIVE SUMMARY:

Type of Change	Impact on System Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Technical	n/a	n/a	n/a
Schedule	Core Capability unavailable until FY 1990.		
Cost		Reduced funding forces staff reduction and schedule delays.	

NARRATIVE DESCRIPTION OF CHANGES (U)

1. TECHNICAL CHANGES: None.

2. SCHEDULE CHANGES:
   a. (U) NTB Program Impact
      o (U) Delays Other Early Capability until FY 1989.
      o (U) Delays NTF construction completion until FY 1990.
      o (U) Delays Core Capability and support of large scale simulations until FY 1990.
   b. (U) SDI Impact:
      o (U) Delays until FY 1990 the means to evaluate and verify the interoperability of SDS elements.

3. COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION:
(U) Request for Proposal F19628-87-R-0005; Statement of Work for the NTB Integration
(U) ESD Contract F19628-88-C-0012; Martin Marietta Implementation of the NTB

G. (U) RELATED ACTIVITIES:
- o (U) Program Element 0603220C, Sensors
- o (U) Program Element 0603221C, Directed Energy Weapons
- o (U) Program Element 0603222C, Kinetic Energy Weapons
- o (U) Program Element 0603224C, Survivability, Lethality, and Key Technologies

H. (U) OTHER APPROPRIATION FUNDS:

o (U) MILITARY CONSTRUCTION: $100M for NTF construction ($35M-FY 1988, $65M-FY 1989). Dollars are included in the current program plan.

Program Element: 0603223C
PE Title: Systems Analysis/Battle Management (U)
Project Number: 45
Budget Activity: Advanced Technology Development (02)

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: Martin Marietta, the prime NTB integration contractor, is working with Ferranti of the United Kingdom to 1) identify issues associated with the interoperability of a European test bed and the NTB and 2) to develop experimental design concepts to support the evaluation of strategic defense system and theater missile defense architectures. The extent of the cooperative effort is yet to be determined.

J. (U) MILESTONE SCHEDULE:

FY 1988 - Early Analysis Capability, Early Operational Capability
FY 1989 - Prototype Capability, Other Early Capability
FY 1990 - Complete NTF Construction, Core Capability
FY 1991 - Continue evolutionary development of capability to conduct simulations and experiments in support of strategic defense system evaluation activities.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Analysis and Battle Management
Project Number: 46
Budget Activity: 02 Advanced Technology Development (U)
Project Title: Strategic Defense (SDS) Phase I Engineering (U)

A. (U) RESOURCES: ($ in Thousands)

Project Number & Title	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Program
SDS Phase I Engineering (U)	45,201	63,470	125,210	155,531	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENTS AND SYSTEM CAPABILITIES

(U) This project supports the system design for the SDS. The threat is the ballistic missile nuclear delivery capability of the Soviet Union. Recognizing that no comprehensive strategic defense system could be deployed all at once, the concept of phased system has been structured. Goals of a Phase I system are:

1. (U) Deny the Soviets confidence in the military effectiveness and political utility of a ballistic missile attack;
2. (U) Secure significant military capability for the U.S. and its allies to deter aggression and support their mutual strategy in the event deterrence should fail; and
3. (U) Secure a defense-dominated, strategic environment in which the U.S. and its allies can deny to any potential agressor the military utility of ballistic missile attack.

(U) Phase I of SDS would be sized and given sufficient capability to achieve specific military and policy objectives and lay the ground work for the deployment of subsequent phases. Phase I would concentrate on boost, post-boost, and late midcourse intercept layers. The boost and post-boost layers could consist of space-based, kinetic-kill interceptors (SBI) combined with surveillance and tracking satellite sensors in geosynchronous orbit. The late midcourse phase intercept layer could consist of ground-launched interceptors, combined with ground-launched surveillance probes or space-based surveillance platforms, to destroy nuclear weapons that were not destroyed in the boost or post-boost layer defense. Subsequent phases of deployment could augment and upgrade Phase I assets.

(U) The major project activity is the Phase 1 System Engineering and Integration effort being conducted by a competitively selected contractor supporting the program in defining system requirements, coordinating system interface requirements, allocating functional requirements to the Phase 1 elements, and participating in integrated systems testing activities. Included in this project is a Phase One Engineering Team (POET), composed of not-for-profit members, that supports Phase 1 and follow-on phase architecture and threat definitions, as well as performing engineering trade-off analyses.

Program Element: 0603223C
PE Title: Systems Analysis and Battle Management
Project Number: 46
Budget Activity: 02 Advanced Technology Development (U)

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS

1. (U) FY1988 Accomplishments: Under other projects within Program Element 0603223C the following were accomplished:

- (U) The Phase One-Engineering Team was initially formed in November 1987 with new members joining the team during the year.
- (U) The System Engineering and Integration contract to develop a system design was awarded to General Electric in May 1988.

2. (U) FY1989 Planned Program:

- (U) Establish an integrated system engineering network located at each element and executing agent across the nation to develop the SDS Phase I system design.
- (U) Conduct an interim review of system requirements and system design activities to prepare for the System Requirements Review in FY1990.

3. (U) FY1990 Planned Program:

- (U) Finalize and flow down mission requirements to the elements.
- (U) Complete development of and release system level "A" specification and element interface requirement documents.
- (U) Identify ground-based facility requirements.
- (U) Complete pilot Command Center initial design.
- (U) Initiate and conduct pilot Command Center demonstrations.
- (U) Conduct a System Requirements Review to establish the initial system design.
- (U) Establish a test program and use results from National Test Bed simulations, technology projects, and element programs to refine the system design.

4. (U) FY1991 Planned Program:

- (U) Control performance requirements baseline.
- (U) Enhance Command Center functionality.
- (U) Conduct the System Design Review.
- (U) Control and refine the system design baseline.

Program Element: 0603223C
PE Title: Systems Analysis and Battle Management
Project Number: 46
Budget Activity: 02 Advanced Technology Development (U)

- (U) Continue pilot Command Center demonstrations at increasing levels of fidelity.
- (U) Continue development of higher fidelity simulations and evaluate test results from National Test Bed.
- (U) Continue evaluation of technologies and effectiveness of SDI research efforts

5. (U) Program Plan to Completion: This is a continuing program.

D. (U) WORK PERFORMED BY: The System Engineering and Integration contract is performed by General Electric, Valley Forge, PA. The Phase One Engineering Team draws its members from the following: Aerospace, Los Angeles, CA; Applied Physics Lab, Laurel, MD; Draper Lab, Cambridge, MA; DMA, Washington, DC; IDA, Alexandria, VA; MIT/LL, Lexington, MA; Mitre, McLean, VA and Bedford, MA; NSA, Ft. Meade, MD; Sandia NL, Albuquerque, NM; USASDC, Washington, DC and Huntsville, AL.

E. (U) COMPARISON WITH FY1989 DESCRIPTIVE SUMMARY:

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	Systems Reqts Review Delayed	N/A	None
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: The system architecture is continuing to evolve as the result of technology projects become known and architecture trade studies are completed. Allocation of system-level requirements to elements is beginning to be established.
2. (U) SCHEDULE CHANGES: The System Requirements Review planned in FY1989 is now scheduled for FY1990.
3. (U) COST CHANGES: None.

F. (U) PROGRAM DOCUMENTATION:

System Concept Paper	4/88
Test and Evaluation Master Plan	6/87
SDI Program Master Plan	4/88

G. (U) RELATED ACTIVITIES:

- Program Element 0603223C, SABM (System Analysis and Battle Management).
- Program Element 0603220C, Surveillance, Acquisition, Tracking and Kill Assessment (SATKA).
- Program Element 0603222C, Kinetic Energy Weapons (KEW).

Program Element: 0603223C
PE Title: Systems Analysis and Battle Management

Project Number: 46
Budget Activity: 02 Advanced Technology Development (U)

- Program Element 0603224C, Survivability, Lethality and Key Technologies (SLKT).
- Related activities involve all Services and Agencies in accordance with DoDD 5141.5, dated June 4, 1987.
- The Phase I SDS System Engineering Project has been created to integrate all Phase I system efforts to preclude any unnecessary duplication of effort.

H. (U) OTHER APPROPRIATION FUNDS: NONE

I. (U) INTERNATIONAL COOPERATIVE EFFORTS: N/A

J. (U) MILESTONE SCHEDULE:

(U) Interim Requirements Review	2Q/FY89
(U) System Requirements Review	2Q/FY90
(U) Establish SDII	FY90
(U) System Design Review	FY92

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603213C
PE Title: Systems Analysis/Battle Management
Project Title: Test and Evaluation

Project Number: 47
Budget Activity: 02

A. (U) RESOURCES ($ in Thousands)

Popular Name	FY 1988 Actual	FY 1989 Estimate	FY 1990 Estimate	FY 1991 Estimate	To Complete
Test and Evaluation	5,861	8,477	9,985	14,977	Continuing

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides for the review and coordination of the overall test and evaluation function within the Strategic Defense Initiative Organization (SDIO) and independent assessment of the Development Test and Evaluation (DT&E) of the Strategic Defense System (SDS). This includes T&E policy and criteria development, test planning and design, evaluation of test results and their dissemination, support and coordination of resource requirements both for individual tests and for the development of future methods and subsystems for testing including the coordination of facilities, construction and target requirements, and central coordination for SDIO with test ranges and T&E units within the Services and their field centers. Specific products resulting from this project are the SDS Test and Evaluation Master Plan (TEMP), Evaluation Reports, Integrated T&E Schedule, T&E Facilities Investment Plan, Target Programing Plan, SDI Integrated Launch Manifest and the SDI Frequency Supportability Plan. This project also provides for the oversight of those activities necessary to obtain frequency support for radio frequency and electro-optical emitters.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) FY 1988 Accomplishments:

- (U) Presentation of treaty compliance information on current testing to the Congress, support in the development of SDIO positions and policy regarding both the INF and START Treaties, and dissemination of new impact information on upcoming testing under INF Treaty constraints.

- (U) Update of the SDS TEMP in support of reviews of the Phase I System by the Defense Science Board (DSB) and the Defense Acquisition Board (DAB).

- (U) Enlargement of the Test and Evaluation Working Group (TEWG) in membership and subcommittee structure to deal with testing problems in greater depth and broader coordination to uncover gaps and overlaps in responsibilities.

- (U) Gathering and updating data on T&E field center and individual SDIO test requirements, costs, schedules, facilities and resources, criteria, measures of effectiveness, data acquisition techniques, and plans for dissemination of results.

Program Element: 0603113C
PE Title: Systems Analysis/Battle Management

Project Number: 47
Budget Activity: 02

- (U) Initiated major funding support to USAF Space Division's studies for the development of a worldwide Space Test Range (STR) on which SDIO would anticipate much use and dependence in the future. The STR will provide for the integration of existing range capabilities and develop planning and coordination to facilitate on-orbit testing and safety.

- (U) Specific, direct support to individual SDIO tests, such as the completion of acquisition to encryption components for the STARLAB Experiment and funding for data gathering aircraft collecting missile plume radiometry and spectrometry.

2. (U) FY 1989 Planned Program:

- (U) Annual update of the SDS TEMP and continue support to SDS Phase I effort including TEMP updates, to greater development of TEWG interfaces and responsibilities, to the STR study, and to improvements in data collection sources and methods for better availability of information to users.

- (U) Increase and initiate new T&E support to the Technologies side of SDIO for follow-on elements of the SDS, participate in the National Test Bed (NTB) validation and verification for SDIP users, and improve data collection and availability to T&E users.

- (U) Initial development of STR capabilities and implementation plan.

- (U) The organization and development of an overall SDIO targets project is now being assigned to T&E as a new effort, and work in this area will grow throughout the year.

- (U) Initiation of a program to define and integrate data management and analysis centers throughout the SDIP to facilitate maximum use of data collected by SDI T&E activities.

3. (U) FY 1990 Planned Program:

- (U) Annual update of the SDS TEMP and intensify support to the SDS Phase I effort in all ways noted above by increasing T&E support to promising weapon and sensor, large-scale development testing under Technologies that will be expanding during this fiscal year. T&E's responsibilities and effort for SDIO targeting will also grow.

Program Element: 0603223C
PE Title: Systems Analysis/Battle Management

Project Number: 47
Budget Activity: 02

c (U) Addition of STR enhancements based on the FY 1989 plan.

4. (U) FY 1991 Planned Program:

c (U) Annual update of the SDS TEMP and greater involvement and support as testing intensifies, especially in the testing of specific elements of the SDS Phase I system, and integrated tests across several elements involving more sophisticated simulation support.

c (U) Support to the Technologies area is anticipated to increase at a moderate pace, as will the SDIO targeting effort during this fiscal year.

5. (U) Program to Completion:

c (U) The T&E support level to the SDIP is expected to increase only slightly in the out years and hold relatively level thereafter as diminished testing is approximately offset by inflation.

D. (U) WORK PERFORMED BY: Support for the small SDIO T&E team is provided by support contractors, including Federally Financed Research Centers and small businesses, such as the Institute for Defense Analysis, The Analytic Sciences Corporation (only through FY 1989), Automation Research Systems, and another contractor currently in source-selection.

E. (U) COMPARISON WITH 1988 DESCRIPTION SUMMARY: This is a new project number. In the FY1988/1989 Congressional Descriptive Summary, the T&E effort described herein was included in the Support Programs summary, Project 07, of this Program Element.

TYPE OF CHANGE	Impact on System Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Technical			
Schedule		NOT APPLICABLE	
Cost			

NARRATIVE DESCRIPTION OF CHANGES

1. (U) TECHNICAL CHANGES: N/A

2. (U) SCHEDULE CHANGES: N/A

3. (U) COST CHANGES: Increasing costs reflect the growth in testing and evaluation activities as the SDIP matures, and earlier developments reach their expected test, demonstration and validation phases.

Program Element: 0603223C
PE Title: Systems Analysis/Battle Management

Project Number: 47
Budget Activity: 02

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES:

- c (U) Program Element 0603220C, Sensors
- c (U) Program Element 0603221C, Directed Energy Weapons
- c (U) Program Element 0603222C, Kinetic Energy Weapons
- c (U) Program Element 0603224C, Survivability, Lethality and Key Technologies
- c (U) Program Element 0604940D, Central Test and Evaluation Investment Program
- c (U) Program Element 0605118D, Director of Operational Test and Evaluation

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATION AGREEMENTS: None directly, but T&E supports joint tests arranged and managed by other offices within the SDIO or their field agents.

J. (U) MILESTONE SCHEDULE: As dictated by Phase I and Follow-on Element test milestones and schedules, or updates to the TEMP to meet DSB and DAB reviews.

FY1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Analysis and Battle Management (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

A. (U) RESOURCES ($ in Thousands)

Popular Name	FY88 Actual	FY89 Estimate	FY90 Estimate	FY91 Estimate	To Complete	Total Program
Innovative Science and Technology	12,835	13,393	28,832	30,802	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES: Explores innovative technologies for systems analysis and battle management. Seeks revolutionary breakthroughs in all technologies that would make a leap in capability for SDI systems analysis and battle management. The funding totals also include all SDI SBIR awards, which make about a third of FY 89 totals.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY1988 Accomplishments: IST research advanced many innovations for consideration by SDI system designers. One researcher won the ADPA Crozier Prize for his neural network research in tracking multiple bodies. Other accomplishments include the following innovations:

- o (U) Calculated that the mid-course problem would be a little less daunting because the warheads would be so clustered in the last 5-6 minutes that the scale of the detection problem would reduce to the square root of their number.

- o (U) Simplified the Joint Probabilistic Data Association Algorithm for finding targets in clutter.

- o (U) Cut beam divergence by two-thirds for stripe domain garnet laser beams to be used for satellite intercommunication.

(U) FY1989 Planned Programs: IST continue to explore the cutting edge of systems and battle management technologies. For example:

- o (U) Demonstrate intersatellite laser communication that is inherently jam-resistant, high data rate, light, and low power.

- o (U) Develop a technology feasibility demonstrator for advanced signal and data processing by merging several independent university type research projects into a central integrator.

- o (U) Continue the search for revolutionary technologies.

(U) FY1990/1991 Planned Programs: Continue exploratory innovations. Specific projects cannot be predicted.

(U) SBIR Accomplishment and Plans: No SBIR Phase 2 has yet been completed. SDI has selected 20 Phase 2 winners in SA/BM technologies. About half have started the Phase 2 work. In FY88 it also selected 10 new Phase 1 winners. The first Phase 2 completions will happen in FY89.

Program Element: 0603223C
PE Title: Systems Analysis and Battle Management (U)

Project Number: 81
Budget Activity: 02
Advanced Technology Development

D. (U) WORK PERFORMED BY: Various institutions (universities, private firms, national laboratories, federally funded research centers) under contract to Army and other agencies.

E. (U) COMPARISON WITH FY88 DESCRIPTIVE SUMMARY: Technical accomplishments are all first-ever events.

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: None

F. (U) PROGRAM DOCUMENTATION: N/A

G. (U) RELATED ACTIVITIES: IST contibutes tchnology advances to all SDI elements and to military and civil applications. Many of technical advances will have wide impact on military and civil technology.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: Not Applicable. Research is the forefront of technology where events cannot be predicted.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: #0603223 Project Number: 83
PE Title: Systems Analysis & Battle Management Budget Activity: 02

A. (U) RESOURCES ($ in Thousands)
Project Title: Support Programs

Popular Name:	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Comp	Total Prog
Support Programs	22,862	53,269	70,558	70,871	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

This project provides funding for Army and Air Force program management, the Strategic Defense Initiative Institute (SDII), the Advanced Research Center (ARC), and the Program Planning function of the Strategic Defense Initiative Organization.

1. (U) The Army and Air Force funding covers expenses for civilian personnel, travel (TDY), training, rents, communications, information management, utilities, printing and reproduction, supplies, equipment, and contracts for research and support services.

2. (U) The SDII, which has not yet been established, would serve primarily as a systems engineering/systems integration FFRDC for the SDIO.

3. (U) The ARC is an advanced computation technology system providing the operational test bed for resolving BM/C3 issues for the SDI program.

4. (U) The SDIO Directorate of Program Planning develops and prepares the SDI Program Master Plan for the technology and systems efforts of the Strategic Defense System.

C. (U) PROGRAM ACCOMPLISHMENTS AND PLANS:

1. (U) The funding provided to the services by this project enables them to centralize recurring operating costs so that funding for technical research may be devoted solely toward that purpose.

2. (U) The SDII would conduct studies and analyses of emerging technologies and systems concepts. The Institute's functions would include, but would not be limited to,

a. (U) identifying and evaluating existing and potential technological advances and systems concepts;

b. (U) reducing the costs and increasing the effectiveness of both basic and applied research;

c. (U) advising SDIO on the utility of integrating each aspect of the SDI program;

d. (U) assessing and developing evolving technical requirements, architectures, and test bed requirements;

e. (U) integrating offense/defense scenarios and analyses into useful conclusions;

f. (U) framing issues for decision by SDIO;

g. (U) developing and maintaining a data base on active SDI projects and capabilities, and continually analyzing these for overlap, duplication, and opportunities for coordination; and

h. (U) coordinating technical tasks and serving as a liaison with the military services, industry, universities, and government laboratories.

3. (U) The ARC will support the SDIO Milestone II efforts in the 1990's. Current facilities at Huntsville (US Army Strategic Defense Command) already support Phase I architecture analysis. Furthermore, it represents the only operational, high-fidelity simulation capable of providing end-to-end BM/C3 issue resolution through 1991. After this time, the ARC will become a major element of the National Test Bed.

4. (U) The funding for Program Planning enables SDIO to establish master schedules of technical and programmatic milestones, develop descriptions of technical program content, and evaluate program progress using risk assessment, technology maturation, and critical path methodologies. The Directorate of Program Planning accomplishes these tasks through its Long-range Planning Divison, Near Term Planning, and Planning Analysis Divisions.

D. (U) WORK PERFORMED BY:

1. (U) Primarily the civilian employees of the Army Strategic Defense Command (Huntsville AL and Crystal City VA) and the Air Force Space Division (Los Angeles). Civilian personnel costs comprise 60% of the support programs funding provided to the services. Work is also performed by the following major contractors:

Integration Support, Ford Aerospace Division, Los Angeles (AF)
Systems Engineering Support, ANSER Inc., Los Angeles, (AF)
C&M for Simulation Center, COLSA Inc., Huntsville (Army)
Systems Engineering Support, GRC Inc., Huntsville (Army)
MIS Software Maint & Ops, Hewlett Packard, Hunstville (Army)

2. (U) A specific site and organization (or organizations) have not yet been selected from which to form the SDII. The Institute, however, would probably be located in the Washington D.C. metropolitan area and initially employ about 50 professionals.

3. (U) The ARC is presently operated and maintained by COLSA, Inc. at the Army Strategic Defense Command in Huntsville.

4. (U) The Program Planning function is performed by the the SDIO Directorate for Program Planning with data base management support services provided by TASC, Inc. and Polaris, Inc.

Program Element: #0603223 Project Number: 83
PE Title: Systems Analysis & Battle Management Budget Activity: 02

E. (U) COMPARISON WITH FY89 DESCRIPTIVE SUMMARY: Support programs have not been separately identified in previous submissions.

IMPACT OF CHANGES

CHANGE	System Capabilities	Schedule	Budget Year Cost
Tech	None	None	None
Schd	None	None	None
Cost	None	None	None

NARRATIVE DESCRIPTION OF CHANGES

1. TECHNICAL CHANGES: N/A
2. SCHEDULE CHANGES: N/A
3. COST CHANGES: N/A

F. (U) PROGRAM DOCUMENTATION: Services submit detailed justification using SDIO. Work Package Directive format to document each year's support program requirements.

G. (U) RELATED ACTIVITIES: Support programs funding for the Army and Air Force are also found in each of the other four SDIO program elements under Project 83.

H. (U) OTHER APPROPRIATION FUNDS: None

I. (U) INTERNATIONAL COOPERATIVE AGREEMENTS: None

J. (U) MILESTONE SCHEDULE: N/A

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603223C
PE Title: Systems Architecture and Battle Management
Project Number: 85
Budget Activity: 02 Advanced Technology Development

A. (U) Resources ($ in thousands)

Project Title / Popular Name	FY88 Actual	FY89 Est	FY90 Est	FY91 Est	To Complete	Total Program
Technology Applications:	1,468	2,710	3,000	3,000	Continuing	
Medical Free Electron Laser	17,000	17,567	19,967	19,965	Continuing	
Total Project 85	18,468	20,277	22,967	22,965	Continuing	

B. (U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

In response to Congressional and Presidential initiatives on competitiveness and technology transfer, the Technology Applications Program was established in 1986 to make SDI technology available to federal agencies, state and local governments, and U.S. business and research interests. The objective of this program is to develop and support the transfer of SDI-derived technology to Department of Defense applications as well as to other federal, state, and local government agencies, federal laboratories, universities, and the domestic private sector. This is being accomplished by:

- (U) Identifying potential private and public sector applications for SDI technologies;
- (U) Evaluating the commercial potential of Small Business Innovation Research (SBIR) contracts awarded to small businesses and minority and disadvantaged organizations;
- (U) Using the Technology Applications Information System (TAIS), a modem-accessible computer data base which currently contains over one thousand SDI technology abstracts;
- (U) Organizing technology applications conferences and advisory panels to provide individuals and organizations the information needed to make the business, licensing, and royalty arrangements required to accelerate the technology's transfer;
- (U) Working with the military services and other Department of Defense agencies to plan for the utilization of SDI-related technologies in on-going and future research programs and chair the Joint SDI-Defense Technology Applications Panel to review potential applications.

Most of the funding in this project, however, is allocated to the Congressionally-directed Medical Free Electron Laser (MFEL) Program. The MFEL progaram seeks to develop and enhance free electron laser technology and to assess how the unique characteristics of FELs may be exploited for applications in medical, biophysical and materials science research.

Program Element: 0603223C
PE Title: Systems Architecture and Battle Management

Project Number: 85
Budget Activity: Advanced Technology Development (02)

C. (U) PROGRAM ACCOMPLISHMENT AND PLANS:

FY 1988 Accomplishments:

- (U) Identification of more than 35 photoactive dyes which enhance the capability of lasers in the treatment of cancer;
- (U) Development of a process, now in use in many hospitals, to fragment kidney stones using a pulsed dye laser;
- (U) Using a free electron laser to cleanly cut live bone without the charring or burning usually associated with the use of the laser;
- (U) Progress in the use of a photoactive dye and a laser as part of the treatment for some types of bone marrow cancer;
- (U) Development of a process to combine laser and balloon angioplasty as a better way to clear blocked blood vessels;
- (U) Use of the laser in the welding of small blood vessel in place of sutures; and
- (U) Research which has produced a method for cleansing donor blood in blood banks of viruses like HIV (AIDS), Herpes, Hepatitus B, and measles.

(U) FY 1989 Planned Program:

Contracts with up to 10 Historically Black Colleges and Universities/ Minority Institutions (HBCU/MI) will be awarded to afford these HBCU/MIs the opportunity to understand the objectives of the MFEL Program research. After 6 months, three contracts will be awarded to HBCU/MIs for a three year research program. Contracts will also be awarded for the development of up to three full clinical prototype radiopharmaceutical delivery systems for positron emission tomography diagnostics. Research under the MFEL Program will continue at the current research institutions.

(U) FY 1990/1991 Planned Program:

The Joint SDI-Defense Technology Applications effort will continue to be emphasized, and the review of SDI technology for inclusion into the Technology Applications Information System computer data base will be maintained. Additional meetings of the technology applications panels to review SDI technology for potential application in biomedical research; electronics, communications, and computer technology; power generation, storage, and transmission; and materials and industrial processes, will be scheduled.

D. (U) WORK PERFORMED BY:

(U) Medical Free Electron Laser Program research is being performed at:

1. Massachusetts General Hospital, Cambridge, MA
2. University of Utah, Salt Lake City, UT
3. Northwestern University, Evanston, IL

Program Element: 0603223C
PE Title: Systems Architecture and Battle Management

Project Number: 85
Budget Activity: 02 Advanced Technology Development

4. Baylor Research Foundation, Dallas, TX
5. University of California, Irvine, CA
6. City College of New York, New York, NY
7. University of Southern California, Los Angeles, CA
8. Uniformed Services University of the Health Sciences, Bethesda, MD
9. Duke University, Durham, NC
10. Stanford University, Palo Alto, CA
11. University of California, Santa Barbara, CA
12. Vanderbilt University, Nashville, TN
13. National Institute of Standards and Technology, Gaithersburg, MD
14. University of Michigan, Ann Arbor, MI
15. Purdue University, West Lafayette, IN
16. Princeton University, Princeton, NJ
17. University of South Florida, Tampa, FL
18. University of California - San Diego, La Jolla, CA
19. University of Texas, Austin, TX

E. (U) COMPARISON WITH FY 1988 DESCRIPTIVE SUMMARY: This program was not treated as a separate project in the previous submission.

TYPE OF CHANGE	Impact on Systems Capabilities	Impact on Schedule	Impact on FY 1990 Cost
Tech	N/A	N/A	N/A
Schd	N/A	N/A	N/A
Cost	N/A	N/A	N/A

NARRATIVE DESCRIPTION OF CHANGES (U)

1. (U) TECHNICAL CHANGES: None
2. (U) SCHEDULE CHANGES: None
3. (U) COST CHANGES: None

F. (U) Program Documentation: MFEL Program Management Plan, October 1988

G. (U) Related Activities: SDIO Directed Energy Program Element, 0603221C

H. (U) Other Appropriation Funds: None

I. (U) International Cooperative Agreements: None

J. (U) Milestone Schedule: Not Applicable

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C
Title: Survivability, Lethality & Key Technologies (U)

Budget Activity: 02
Advanced Technology Development (U)

A. (U) RESOURCES ($ in Thousands)

Project Number	Title	FY 88 Actual	FY 89 Est	FY 90 Est	FY 91 Est	To Comp	Total Prog
50	System Survivability (U)	91,305	102,991	169,450	218,114	Continuing	
51	Lethality & Target Hardening (U)	63,641	62,218	124,434	152,128	Continuing	
52	Power & Power Conditioning (U)	97,204	99,509	205,295	236,979	Continuing	
53	Space Transportation & Support (U)	79,553	55,000	124,809	154,750	Continuing	
54	Materials and Structures (U)	24,390	30,731	68,428	86,061	Continuing	
55	Countermeasures (U)	21,245	22,270	34,994	42,356	Continuing	
81	Innovative Science & Tech (U)	23,600	18,376	40,905	48,610	Continuing	
83	Support Programs (U)	23,131	15,248	8,472	8,578	Continuing	
TOTAL FOR PROGRAM ELEMENT (U)		429,574	406,343	776,787	947,576	Continuing	

B. (U) BRIEF DESCRIPTION OF ELEMENT: This program element is one of six established to implement the President's Strategic Defense Initiative and provides for development of key technologies, such as space launch, and for research into critical issues, such as weapon effectiveness and system survivability, which must be separated from the system or technology proponent to ensure impartial assessments. Specific activites include:

1. (U) Developing technologies and tactics to ensure the functional survivability of potential elements of a strategic defense system in the face of a determined Soviet effort to render it ineffective.

2. (U) Reducing the major uncert[illegible]ties in SDI's knowledge of weapon effects and target vulnerability thereby providing essential knowledge needed by system designers trading off system size and technical approaches.

3. (U) Development of electrical power generation and conditioning technologies for strategic defense elements requiring large amounts of specially conditioned electrical power.

4. (U) Developing technologies to improve significantly space transportation and support capabilities including transportation to orbit and repair/resupply on orbit.

5. (U) Performing research on materials and large-scale structures for elements of a strategic defense.

6. (U) Identifying likely Soviet countermeasures to strategic defense system concepts and/or individual system components.

7. (U) Promoting research in fundamental science and engineering in technical areas applicable to ballistic missile defense.

FY 1990/1991 BIENNIAL RDT&E DESCRIPTIVE SUMMARY

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 50
Budget Activity: 02 Advanced Technology Development

A.(U) RESOURCES ($ in Thousands)
Project Title Survivability Project

Popular Name	FY 1988 Actual	FY 1989 Estimate	FY 1990 Estimate	FY 1991 Estimate	To Complete	Total Program
Survivability	91,305	102,991	169,450	218,114	Continuing	

B.(U) BRIEF DESCRIPTION OF MISSION REQUIREMENT AND SYSTEM CAPABILITIES:

(U) The Survivability Project is responsible for assuring that SDS can survive a determined Defense Suppression Threat (DST). The FY 89/90/91 Survivability Project will focus on ensuring appropriate survivability technology developments will support Full Scale Development (FSD) for Phase I Elements. Issues addressed in this Project include Survivability Analysis and Modeling; Technology Development; Technology Transfer; and Test, Validation, and Evaluation. Threat Definition Responsibility, formally a responsibility of the Survivability Project, has been transferred to Program Element 0603223C.

1.(U) Survivability Analysis and Modeling - The Survivability Project has shown that "individual survivability options vs. individual threats" is an adequate approach for SDI survivability needs. Studies have shown that by combining suites of survivability enhancement options, cost-effective, synergistic survivability results.
2.(U) Technology Development - Survivability technologies for Phase I are being developed and demonstrated for protection against DSTs.
3.(U) Technology Transfer - We are requiring contractors to develop and implement infusion plans to incorporate available technology.
4.(U) Test, Validation, and Evaluation - Aggressive Above Ground Testing (AGT) and Underground Testing (UGT) are accomplished to prove technologies. The Integrated Survivability Experiment (INSURE) will comprise a major portion of the FY 90/91 effort. This program validates survivability technologies in as near to operational configuration as possible prior to MS II.

(U) The above items, taken as a whole, will provide SDS with the validated technologies and concepts necessary for overall SDS survivability.

C.(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1988 Accomplishments:

- c (U) Defensive Shield Demonstration (DSD): preliminary designs completed, continued laser and KEW tests.
- c (U) Developed optics vulnerability database; began hardness improvements.
- c (U) Performed additional AGTs on new optical coating techniques to demonstrate JCS or higher vulnerability levels.

Program Element: 0603224C
PE Title: Key Technologies

Project Number: 50
Budget Activity: 02 Advanced Technology Development

- o (U) Refined analytical techniques to predict survivability levels of optical components.
- o (U) Demonstrated Laser Hardened Materials Evaluation Lab (LHMEL) at 100 kW laser output.
- o (U) Selected material and design for prototype shield against pellets and lasers.
- o (U) Demonstrated laser hardening technology for SDI components.
- o (U) Conducted component laser validation tests of sensor train and external deployable antennas.
- o (U) Determined Beryllium (Be) mirror manufacturing process guidelines.
- o (U) Completed first cycle of AGT vulnerability data base development for Mercury-Cadmium-Telluride (HgCdTe) IR detectors.
- o (U) Tested components in preparation for Mineral Quarry UGT.

(U) FY 1989 Planned Program:

- o (U) Passive survivability technology development to support Phase I elements by Milestone II:
  - -(U) Laser hardened structures, adhesives, radiators, attitude controls, and insulation for SBI and SSTS
  - -(U) Laser evaluation of mission critical optical sensors
  - -(U) Nuclear hardening for components, optics, and structures for SBI, SSTS, BSTS, ERIS, and GSTS.
  - -(U) Laser and KE spacecraft shields for SSTS and SBI
  - -(U) Material/component characterization, evaluation, and validation of survivability technology
  - -(U) Evaluation of NPB and HPM/EW threats against Phase I Elements
- o (U) Active technology efforts in FY 1989 include:
  - -(U) Short and long term tactical decoys for low and medium earth orbit satellites
  - -(U) Optical and Electronic Countermeasures (OCM/ECM)
  - -(U) Element software circumvention/reconfiguration, BM/C3 signature reduction
  - -(U) Pre-deployment and operational technologies for ground-based Elements
- o (U) Validation and Verification testing of survivability technologies via AGT/UGT in support of INSURE
- o (U) Conduct systems survivability/assessments, generate survivability specifications, develop technology requirements, conduct tests and evaluations

(U) FY 1990 Planned Program:

- o (U) Continue efforts from the FY 1989 Project to support Phase I technology requirements.
- o (U) Continue technology/survivability programs from FY 1989 Project:
  - -(U) Laser Hardening: Hardened Component/Designs, Hardened

END